OCTOBER - 1956

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ELECTRICAL CONSTRUCTION AND MAINTENANCE

WITH ELECTRICAL CONTRACTING

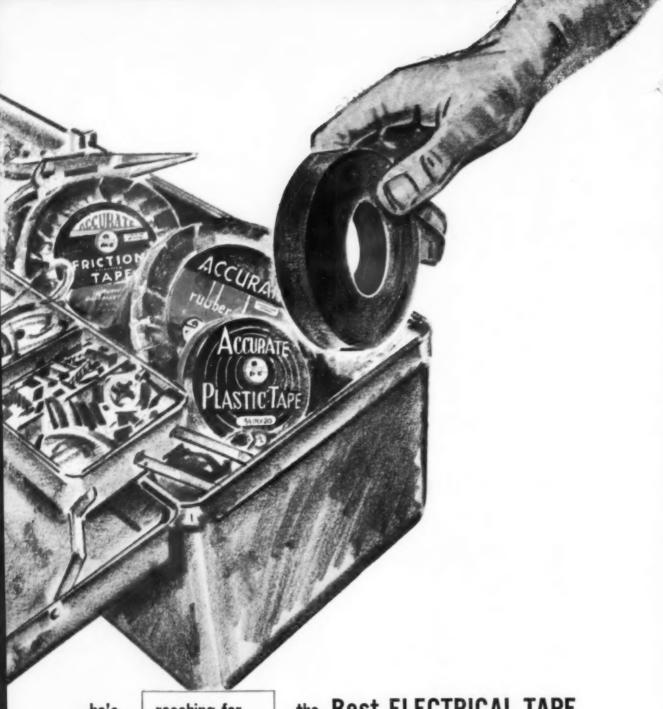
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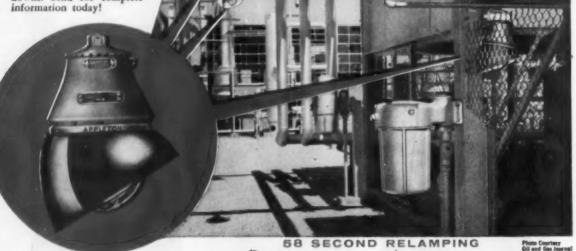
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Standardized diameters at top of Dome Unit Assembly permit interchange with AA-51 fixtures of varying wattages.

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56th Year OCTOBER • 1956

Published for electrical contractors, industrial electricians, engineers, consultants, inspectors and motor shops. Covering engineering, installation, repair, maintenance and management, in the field of electrical construction and maintenance.

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October 1956

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W. T. STUART, Editor

Subscriptions are solicited only from persons engaged in electrical construction or electrical maintenance. Position and company connection must be indicated on subscription order.

Single copies 336. Electrical Products Guide 2.50 to these in the electrical position of the complex of the c

-Sidelights

REWIRING—Apartment house electrical modernization presents a number of exacting design and work scheduling problems. The premises are occupied 24 hours a day, and interruptions of service must be kept to a minimum. In the interests of economy, the work must proceed during normal working hours.

An Englewood, N. J., project provides a detailed case study, this month, of the problems presented by this class of work and the practical plans and methods which were evolved for handling them. Distribution and branch circuit layout were revamped to provide power for air conditioners and increased electric appliance utilization. The installation is described in "Apartment House Rewiring" (page 115) by Arthur N. Reichel of New Jersey Electrical Engineering, Inc. Busch Bros., Inc. also of Englewood were the electrical contractors.

SHOP PLANNING—Motor shop physical layout is often a desperate compromise between the demands of growing business volume, mechanization, employee and customer facilities, and the inflexible limitations of existing buildings. Once in a while, an organization has the opportunity to build anew and to incorporate a growth plan into the structure.

Joe and Jim Previty and Fred Pi-

sano, partners in the Penn Electric Motor Co. of Philadelphia, had such an opportunity and celebrated the company's 20th anniversary with the dedication of a new shop in which practical experience and forward looking plans have provided a high order of flexibility for future expansion with top efficiency. The details are presented in "Shop Layout Designed for Growth" beginning on page 134.

STANDBY RACEWAY – At the world's largest drive in theater on Long Island, electrical contractor M. Eisenberg and Bros., Inc. have recently completed a sound wiring installation using direct-burial UF cable with a complete standby plastic conduit raceway system to serve 2560 speakers. The raceway provides for convenient by-passing of faults with new cable in the event that trouble develops in any part of the original installation and also provides for any new circuitry or modification required for the future. The on-the-job story of the project is reported by Bill Novak in "Drive-in Theater Sound System", page 123.

EXPOSITION WIRING—Electrical equipment and capacity to serve the Mid-America Jubilee Exposition on the St. Louis waterfront would take care of a city of 7500. The power and lighting system was installed by Sachs

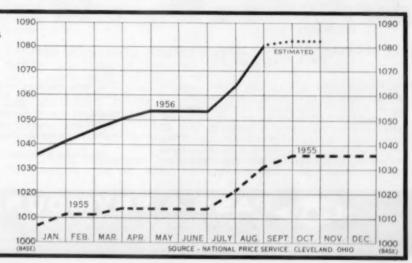
Electric Co. to provide for the participating industrial, agricultural, commercial and theatrical exhibits and concessions, and employed a number of novel installation techniques. A nostalgic feature was the wiring of an authentic, old-time beer garden recreating the atmosphere of 1904. Gas lamps, converted to electric, connected on open wiring, simulated the wiring practices used at the turn of the century. See "Electrical Notes on Mid-America Jubilee Exposition", page

WILD BIDS?—Marked variations in competitive bids, sometimes characterized as "wild", are not necessarily so, according to Consulting Engineer Ray Ashley. He reviews, this month, some of the basic reasons behind bid variations in "Bid Spread" beginning on page 129.

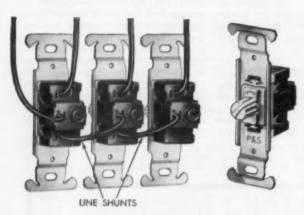
HEATING COSTS—Comparison of electric heat costs with the operating costs of fuel fired systems involves considerations and factors favorable to electric heating that may sometimes be overlooked. From research studies in the Pacific Northwest, J. C. Beckett explores the factors of energy rate efficiency and utilization for electric heat in comparison with natural gas, oil and propane fired systems. See "Cost Comparison", page 132.

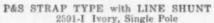
COST INDEX

BASE LINE (1000) REPRESENTS COSTS OF TYPICAL
ASSORTMENT OF MATERIALS FOR A SELECTED JOB
AS OF NOVEMBER 1, 1951.
INDEX POINTS REPRESENT
THE VARIATION OF THESE
SAME MATERIAL COSTS AS
OF THE FIRST OF EACH
MONTH.

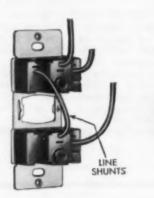


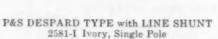






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The new roto-type switch mechanism and nonoxidizing silver alloy contacts are totally enclosed in a plastic body, assuring longer switch life and improved overall operation.

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Washington Report

Cost of living dropped 0.2% in August to 116.8% of the 1947-49 average, to break a six-month slow rise, BLS has reported. This is 2% above the year-ago index, and the second highest on record.

At the same time, BLS announced, the amount of goods and services factory workers could buy with their August pay (a record high of \$79.79 weekly average), was the highest it had ever been for August, reflecting increased purchasing power.

The mild increase in cost of living over the past four years, from an FRB index of 113.2 in 1952 to 117.0 in July 1956, is being heralded by many as inflation, which Administration officials are quick to point out has nothing to do with inflation (an increase in supply of money larger than increase in production) but is rather an increase in costs.

Housing starts in August increased over July, breaking the downward trend, but were still well below August of last year, Labor Dept. reported. Builders started work on 100,500 privately-financed dwelling units in August, compared with 99,100 in July, 122,300 in August of 1955.

Government last month took four steps to spur home building, following pressure from National Association of Home Builders earlier in September. Steps taken were made effective on date of announcement, and cut down-payments on homes, increased borrowing limit for Home Loan Banks, further eased curbs.

New construction expenditures during August reached a record \$4.3 billion, \$56 million above August 1955. Private building totaled \$2.8 billion, while public works totaled \$1.5 billion. Public work accounted for all the gain, while private building declined slightly.

Business spending for new plant and equipment during the 3rd quarter was cut back slightly from previous plans and estimates, but 4th quarter spending will reach a new high, Dept. of Commerce and Securities and Exchange Commission reported following recent survey. Total spending this year will be \$35.3 billion, it is estimated, compared with 1955's record \$28.7 billion.

Road-building agencies will spend a record \$8.2 billion this year on streets and highways, Bureau of Public Roads reports.

Industrial production in August was at 141% of the 1947-49 average, same as June, reflecting recovery from July's steel strike. With auto production being stepped up on new models, total production should continue to rise. An increase of one index point monthly will match last year's boom levels.

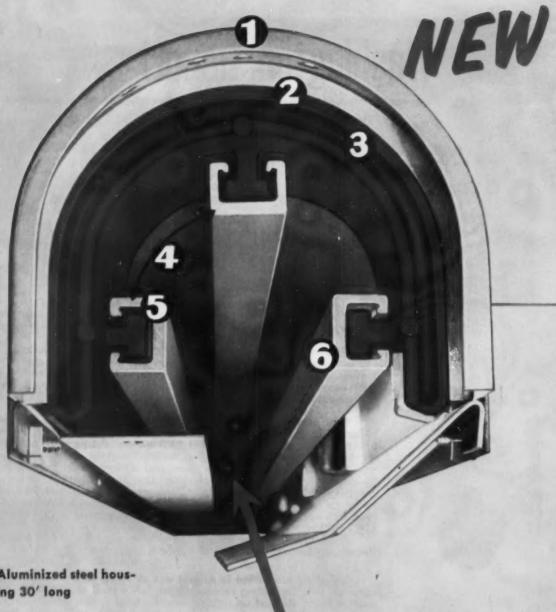
Steel production in 1956 will total an estimated 113 to 115 million tons, in spite of loss in production due to steel strike. This is nearly equal to last year's record 117 million tons.

Production of aluminum in July hit a new high of 151,600 tons. The previous high was in May, when 150,800 tons were produced. Production in July a year earlier was 132,700 tons.

Copper consumption has been rising, with prices remaining firm at 40 cents/lb., but production also continues to rise, staying above demand.

Civilian employment in Government dropped 3000 last year (fiscal 1956, ending June 30), while the Federal payroll rose \$900,000, as compared with 1955. Civilian employment in Government averaged 2,364,000 in fiscal 1956, 1,618,000 in fiscal 1946. Payroll in fiscal 1956 was \$10.5 billion, in fiscal 1946, \$6.4 billion.

Strike losses in July totaled 13.6 million man-days, due mainly to the steel strike. Monthly average during first half of year was 2.1 million mandays. The July record was the largest loss since July 1952.



- Aluminized steel housing 30' long
- Rigid insulator support
- Rugged petticoat insulator
- Maximum leakage disfances
- Trolley rolls on aluminum bus bars
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"SAFETY-SLOT" COVER FOR MAXIMUM SAFETY

Elbowed trolley arm passes freely along slotted bottom cover but accidental contact with current-carrying members of system is practically impossible. A positive guard for personnel.



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HEAVY-DUTY LIGHTWEIGHT TROLLEY BUSWAY SYSTEM

Fast-action INSTALLATION... Safety-first POWER

THE NEW LIGHTWEIGHT SYSTEM FOR CRANES, HOISTS, STRAIGHT-RUNWAY EQUIPMENT

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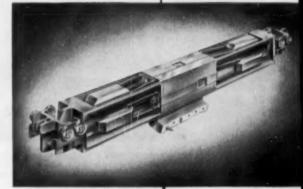
And the system starts paying its board and keep right away. Because of its preassembled units, its lightweight aluminum bus bars, its longer track sections and simple design, it saves you on installation. Write today for complete data.

SAFETY-FIRST with fully enclosed steel housing. Maximum protection against contact with current-carrying bus bars from any direction. Built-in safety lets you locate system where most convenient—indoors or outdoors.

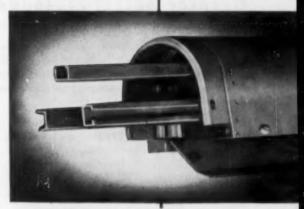
RUGGED to take rough treatment, heavy continuous duty. Corrosion-resistant aluminized steel housing, high-strength aluminum alloy bus bars, petticoattype insulators, sturdy trolley with massive components for

extra severe operating conditions. Most efficient A.C. or D.C. service, greatest phase-to-phase leakage distance with delta conductor arrangement.

FAST, EASY to install and service. Prefab units cut installation time considerably; longer track sections mean fewer joints, rigidity of track requires fewer hangers. Removable safety covers make every part easily accessible. System can be relocated, expanded or altered with a minimum of effort.



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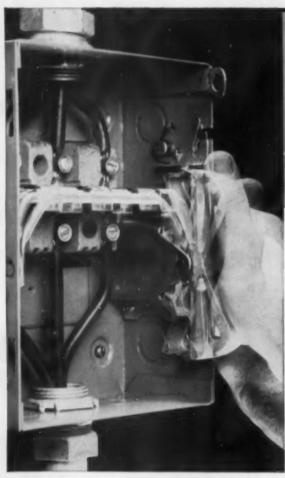


PREASSEMBLED UNITS cut installation time, carefully engineered components make servicing and alterations fast, easy, safe.

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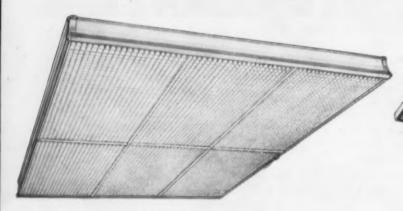
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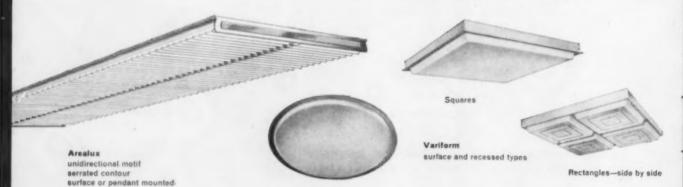
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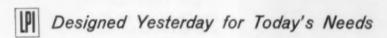
and Esthetic Design

LUMINAIRES

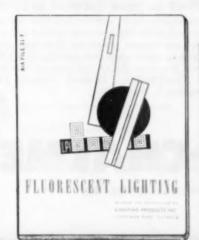
Unquestionably . . . large area luminous elements are the best medium for providing adequate illumination to meet the requirements of modern lighting. But esthetic values often have suffered because a wide variety of large area luminaires was not available.

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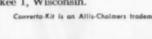
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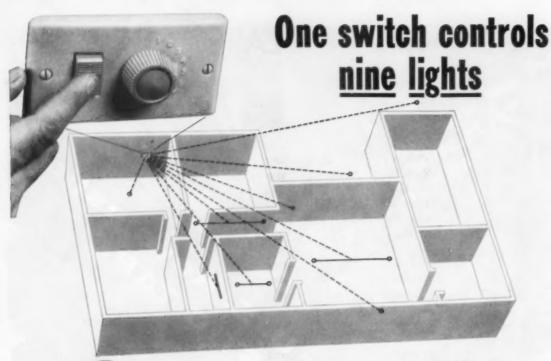
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ELECTRICAL CONSTRUCTION AND MAINTENANCE . . . OCTOBER, 1956



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EASY AND PROFITABLE TO INSTALL . . . General Electric remote-control wiring is one of the most effective sales features any new house can have - and it's quick, simple, and inexpensive to install.

Lightweight, flexible wire is easy to work with . . . strips clean, can be stapled quickly yet securely to framing. All pigtails and wire leads are color-coded for positive identification to speed installation. Selector switches operate up to nine circuits in and around the home, offering home buyers added safety, comfort, and stepsaving convenience.

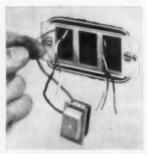
FOR AS LITTLE AS \$35 PER HOUSE. With all its advantages, G-E remote-control wiring is economical for homes in any price range. The complete installed cost is surprisingly low - averaging throughout the country only about \$35 to \$70 per house more than conventional wiring. It's a home-selling feature that means more wiring contracts, more profit for you.



rugged, riveted construction. Actu- quickly stapled to framing. ared by low-voltage current.



REMOTE-CONTROL RELAY has a LIGHTWEIGHT WIRE used in the COLOR-CODED LEADS mean less



Nylon-insulated, positive switching low-voltage circuits — is flexible, easy chance for error . . . make connec-mechanism, heavy contact supports, to work with, and strips clean. Is tion identification and installation of switches quick and easy.



G-E CONTRACTORS' MANUAL shows you how to lay out, estimate, and install G-E remote-control wiring. Involves wire-saving and timesaving ideas to minimize installation costs.

For copies, write to Wiring Device Department, General Electric Company, Providence 7, R. I.

Progress Is Our Most Important Product

GENERAL (ELECTRIC

Two Outstanding CLARK CONTROLS for "Cushioned" Motor Starting

CLARK Increment Starters for Part-winding Motors and CLARK Reduced Voltage, Primary-resistor Type Starters are ideal for providing "cushioned" acceleration where requirements of the mechanical or electrical system indicate reduced torque-and-current starting. Both types offer the advantage of smoother acceleration and power application since the motor is not disconnected—eliminating mechanical and electrical shocks on the second step of acceleration. Both are available in sizes 1 through 7, with sizes 4 and smaller using the famous Clark Type "CY" starters which are setting new standards for dependability, low maintenance, and long life. Compact enclosures feature "safe-edge" design and generous wiring space.

CLARK INCREMENT STARTERS FOR PART-WINDING MOTORS

Where part-winding motors can be used, this starter offers definite economical advantages. Because it has no resistors and uses smaller size contactors, a single compact enclosure reduces space requirements, and the initial cost is low compared to other types.

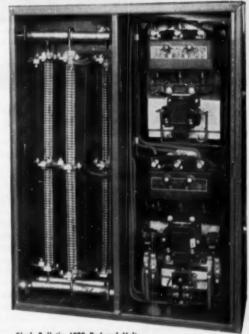
CLARK PRIMARY-RESISTOR TYPE REDUCED VOLTAGE STARTERS

This starter is applicable where higher starting torque is required. It offers greater flexibility of starting requirements and can be used on any squirrel-cage motor. It features the CLARK Edgewound non-breakable resistors—contactors and resistors are mounted in isolated compartments—where both are readily accessible.

For complete information on Clark Controls for "Cushioned" Starting, contact your nearest Clark sales office or write us direct.



Clark Bulletin 6090 Increment Type Starter for Dart-Winding Motors. Integral Hinged Cover not shown.



Clark Bulletin 6080 Reduced Voltage Starter—Primary Resistor Type. Integral Hinged Cover not shown.

The CLARK

Engineered Electrical Control



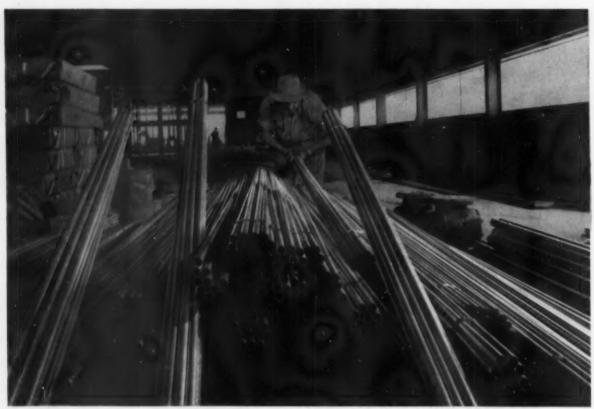
CONTROLLER (

1146 East 152nd Street

Company

Cleveland 10, Ohio

IN CANADA: CANADIAN CONTROLLERS, LIMITED . MAIN OFFICES AND PLANT, TORONTO



44,000 ft. of SPANGLEAM EMT went into this job at High Voltage, Inc., to serve 16 high-voltage atom smashers producing cobalt radiation for cancer treatment, Installation will consume 4,000 kw daily.

"We prefer SPANGLEAM EMT over all others for its ease of handling"

-says Mr. Howard Linstead, Field Superintendent

M. B. Foster Electric Co., Boston, Mass.

Mr. Linstead is supervising the electrical installation of High Voltage, Inc., Radiation Plant at Burlington, Mass., where 44,000 ft. of spanGleam EMT are being installed. Specifications also call for 11,000 ft. of Spang HD Conduit in certain areas.

"The fact that spanGleam EMT is 33% faster to work with than rigid conduit and can be embedded in concrete dictated our choice on this job," reported Mr. Linstead.

"Spang Conduit arrives in good condition. We are not faced with the necessity of over-ordering in order to have a material margin of safety. We can keep material costs down, which assists in bidding. And we can rely on the quality of Spang in application; this not only speeds our work but sometimes makes the difference between profit and loss when the job is completed.

"Because the interior of Spang Conduit is smooth, we have no snagging in our snake-through. The conduit is uniform, and bending requires a minimum of effort. We also find that the owners are pleased, too, with the highly decorative appearance of the spangleam finish in exposed conduit installations."

You can profit, too, with quality-controlled spanGleam EMT on your next job. Your nearby Spang Distributor will give you top-quality service on your order. Make spanGleam EMT your first choice—always!



Workers report SPANGLEAM EMT is easy to bend, uniform. Smooth interior simplifies snake-through. SPANGLEAM EMT is embedded in concrete at many places in the plant. Installation time is 33% faster than with rigid conduit.



SPANG-CHALFANT

Division of the National Supply Company GENERAL SALES OFFICE: TWO GATEWAY CENTER, PITTSBURGH, PA. District Offices and Sales Representatives. Architect: Carleton R. Richmond, Jr., Cambridge, Mass.
Consultant: Henry L. Kennedy, Boston, Mass.
General Contractor: Aberthaw Company, Boston, Mass.
Electrical Engineers: Slocum & Fuller, Boston, Mass.
Electrical Contractor: M. B. Foster Electric Co., Boston,
Mass.

Spang Distributor: Westinghouse Electric Supply Co., Boston, Mass.



Electricians everywhere are saying, "The new C-H 4151 is IT. There is nothing like it on the market." You'll say so too...for three big reasons. It installs easier. It works better. It lasts longer. Check these features.

Installs easier—The high strength phenolic molded unit base can be easily removed and replaced by two screws for 3-point mounting of the enclosing case and wire pulling freedom. All "easy-tite" terminals are out-front eliminating skinned knuckles and wire "pretzel" bending. "Easy-tite" terminals make wiring as simple as one, two, three. 1. Insert wire in hole provided. 2. Pull down to screw terminal. 3. Tighten.

Works better—Solid silver double break butt type contacts have long been standard equipment on quality motor control, and now Cutler-Hammer's exclusive A-c design incorporates all these features in the midget 4151 safety switch. Positive break of the butt type contacts is accomplished by the cam-

ming action of the toggle operator. A non-current carrying compression spring snap-closes the contacts when flipping the toggle to the "on" position. This spring can't heat and lose its tension; therefore, always insures constant and uniform contact pressure.

Lasts longer—Top performance at low cost is due to the 4151 being engineered for A-c service exclusively. Face-to-face closing of butt type contacts receive only a fraction of the wear common to other general use safety switches. Double break contacts halve the arc voltage and further increase the contact life. Solid silver contacts are known to have superior life to either copper or bronze. A Cutler-Hammer "first." A Cutler-Hammer exclusive.

Cutler-Hammer "first." A Cutler-Hammer exclusive.
Order the C-H 4151 midget Safety Switch from
your authorized Cutler-Hammer Distributor today.
CUTLER-HAMMER, Inc., 1306 St. Paul Ave.,
Milwaukee 1, Wis.



4151-H241 30 Amp. 2 wire S/N; 1 Fuse. 120 Volts A-c. Dimensions: 2¾ x 5¼ x 2¼ x. List: \$4.20



4151-H201 30 Amp. 2 Pole; 2 Fuses. 120/240 Volts A-c. Dimensions: 4" x 5%" x 2%". List: \$5.20



4151-H341 30 Amp. 3 wire S/N; 2 Fuses. 120/240 Volts A-c. Dimensions: 4"x5%"x2%". List: \$5.50





Cable splices made faster, last longer in toughest "proving ground" here in The Bessemer Limestone and Cement Company's quarrying operation. Note the rough surfaces over which the cable is dragged. Under conditions that vary from extreme dryness to complete submersion, Bessemer reports exceptional results from the rugged splices made with Okonite Tapes.

Okonite Tapes reduce down-time for Bessemer shovels

The Bessemer Limestone and Cement Company has reduced down-time on its electric shovels two ways by using Okonite Tapes in splicing its high voltage portable shovel cables. First, tough, waterproof splices can be made in the field without taking the cable to the shop and without buying any special molds and other equipment. Second, splices made with Okonite Tapes have been in service since 1948 without added time-loss in remaking.

Cables and splices are dragged over rocks, frequently lie completely submerged in water, and are constantly exposed to sun, rain, snow and ice. Yet Okonite splices have maintained their waterproof toughness for seven years of this treatment. No wonder Bessemer has standardized on Okonite Tapes.

Each splice is designed to give maximum electrical and mechanical protection for operation at 4160 volts. Okolite Corona-Resisting Tape fuses into a solid wall of self-vulcanizing high voltage insulation. Over the shielding tape applied about the three-conductor core, a solid wall of Okoprene Weather-Resistant Tape gives full neoprene protection to the splice. This combination of Okolite and Okoprene Tapes provides the toughness and complete moisture resistance necessary for continued service under such severe operating conditions.

Specify Okonite tapes for the tougher jobs. Get them from your Okonite Tape Distributor, or write to The Okonite Company, EC Tape Department, Passaic, New Jersey.

Available Through Authorized Distributors Only.

OKONITE (



splicing tapes

3522-A

YELLOW IN DANIEL WOODHEAD PRODUCTS

MEANS GREATER SAFETY

PROTEX

MULTI-TAP OUTLET BOX

AT LAST...A Real Step Forward in Portable Hand Lamp Design and Safety

THE NEW "SAFETY YELLOW" NEOTEX

VAPRATEN

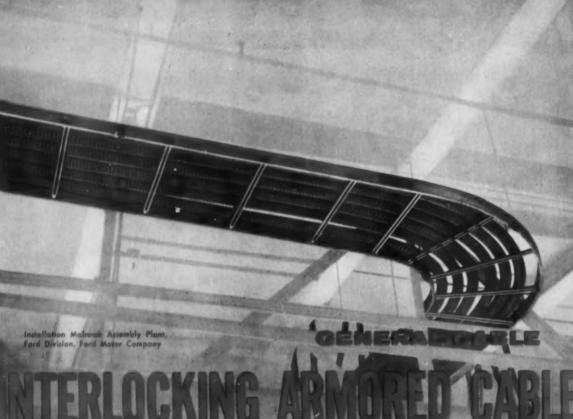


Now...PROTEX and VAPROTEX portables...and the new Multi-Tap outlet box are an even better value...made of oil-proof "SAFETY YELLOW" NEOTEX for...greater safety-better visibility • non-pilferage • sure product identification

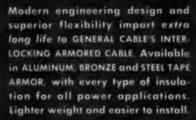
Write Us Today...for complete product and price information

DANIEL WOODHEAD COMPANY

15 N. JEFFERSON ST. . CHICAGO 6, ILLINOIS



SAFE DEPENDABLE ECONOMICAL



GENERAL CABLE CORPORATION, 420 Lexington Avenue, New York 17, N. Y. Offices and Distribution Centers Coast-to-Coast.



BE SPECIFIC ... SPECIFY GENERAL

CABLE



Here is a lighting unit that does something about room temperatures, too! The new 2-in-1 Benjamin Multi-Vent Trofferlite delivers both the most modern illumination and improved air diffusion from the same fixture at a decided cost saving. It brings you well-diffused, adequately-shielded Benjaminengineered light conditioning, in combination with a new advance in gently-diffused, draft-free air conditioning. Ceilings take on a modern, uncluttered look because air diffusers are concealed inside the clean-lined troffer lighting units. Installation costs dip way down, as the 2-in-1 feature reduces the number and variety of fixtures required. Wherever light and air conditioning are needed, specify Benjamin Multi-Vent Trofferlites to make the job simpler, the design more beautiful, the air conditioning more successful and the cost much lower! Send for FREE illustrated 8-page Data Brochure. Write Benjamin Electric Mfg. Co., Dept. H, Des Plaines, Illinois.

Now — Advanced Benjamin Light Conditioning
PLUS Greatly Improved Air Conditioning from one unit!

No double installation problems!

Improved draft-free air conditioning!

Benjamin-engineered illumination!

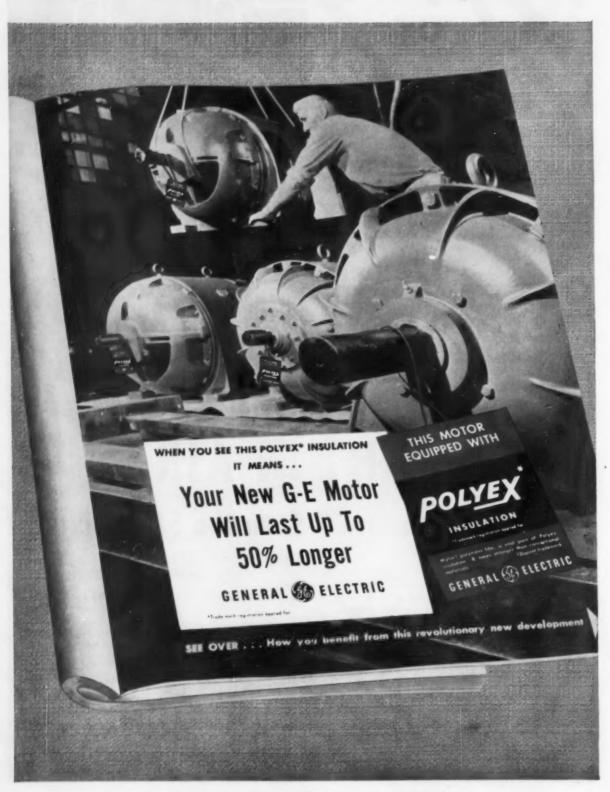
No discord of fixtures!

BENJAMIN MULTI-VENT TROFFERLITE

2-IN-1 LIGHT AND AIR DIFFUSION SYSTEM
Trofferlite by Benjamin Electric Mfg. Co. • Multi-Vent® Air Diffuser by Pyle National Co.

B-1411

Du Pont MYLAR helps G.E.



extend motor life up to 100%



IN A RECENT magazine advertisement, the General Electric Company made an important announcement: Thanks to new "Polyex" insulation, G-E large motors will now last up to 50% longer. SINCE THEN, FUNCTIONAL TESTS BY GENERAL ELECTRIC INDICATE THAT LARGE MOTORS WILL LAST UP TO 100% LONGER.

Attached to the ad was a tag (reproduced above) which called attention to the fact that Du Pont "Mylar" polyester film is a vital component of this new G-E "Polyex" system—the system that delivers up to 100% more life expectancy on a piece of major electrical equipment.

Two outstanding properties found in "Mylar" were

primarily responsible for its selection as a vital component. The first was dielectric strength . . . 4,000 volts per mil with a power factor of 0.003 at 60 cycles. The second property was specifically mentioned on the tag . . . "8 times stronger than conventional (insulating) material."



By using "Mylar" in "Polyex" insulation, G.E. is assured these important extras:

- Thermal stability over a wide range of operating temperatures for greater overload protection.
- Longer life and more reliable service because of the high dielectric and physical strength of "Mylar".
- Resistance to most chemicals, acids, solvents, oils and moisture, which means more versatile motors.

This is but one of many examples where insulation made with "Mylar" has helped leading manufacturers improve product performance and extend product life.

Next time you plan to buy or specify motors, investigate the extra dividends now found in motors insulated with "Mylar". If you're interested in more detailed information on motors insulated with "Mylar", send in the coupon for our new booklet.

†"MYLAR" is Du Pont's registered trademark for its polyester film.

† "DACRON" is Du Pont's registered trademark for its polyester fiber.



DU PONT			
M	YL,	A	R®
	POLYE	STER	FILM

_	t featuring "Mylar" in motors (MB-5).
Application	
Name	

witch is to PYLE-NATIONAL the

industrial lighting fixtures

EXPLOSION-PROOF

LE Series (Clase I, Groups C and D) 60 to 500 Watts Choice of body and reflector styles



DUST-TIGHT

DE Series (Class II, Groups E, F and G and Class III) 60 to 200 Watts Choice of body and reflector styles



VAPOR-TIGHT

DO Series 10 watt signal or pilot lights BO Series 50 to 500 watts Choice of body and reflector styles



FLUSH VAPOR-TIGHT

Type 1570 Pit and subway lights 100 and 200 watts



Literature Furnished On Request

Sold Nationally Through Authorized Distributors

LE-NATIONAL COMPANY

WHERE QUALITY IS TRADITIONAL

1344 N. Kostner Avenue, Chicago S1, Illinois

Branch Offices and Agents in Principal Cities of the U.S. and Canada • Canadian Agent: The Holden Co., Ltd., Montreal
Railroad Export Department: International Railway Supply Co., 30 Church St., New York 7, N.Y.
Industrial Export Department: Rocke International Corp., 13 E. 40th St., New York 16, N.Y.

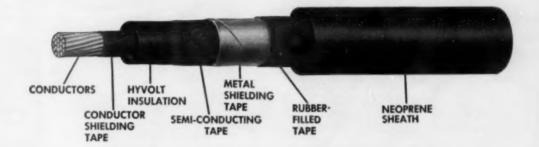
CONDUIT FITTINGS • PLUGS AND RECEPTACLES • TURBO-GENERATORS • MULTI-VENT AIR DISTRIBUTION



CRESCENT



HYVOLT SHIELDED POWER CABLE



For More Amperes Per Dollar of Installed Cost

DVANTAGE

- 1. Long life
- 2. Can be operated at 85°C. Permits smaller conductors or more amperes per conductor.
- 3. Freedom from corona cutting
- 4. Excellent resistance to moisture
- 5. Low power factor and dielectric loss
- 6. Lighter, more flexible, easier to handle and install than lead covered cables
- 7. Electrolytic or chemical corrosion of lead sheath is eliminated by use of neoprene sheath
- 8. Shielding prevents possibility of surface burning and provides safety to human life.

CRESCENT HYVOLT insulation is made from butyl rubber which is inherently resistant to ozone, heat, moisture and aging. HYVOLT is formulated and processed so as to retain these inherent characteristics of the butyl rubber and at the same time provide excellent electrical and physical properties.

The insulation is protected during and after installation by an outer neoprene sheath providing a maximum degree of toughness, durability and long life. It is flame retarding and resistant to the deteriorating effects of moisture, sunlight, ozone (corona), oil, grease, and many acids and alkalies.

HYVOLT Shielding provides additional internal and external protection in these THREE WAYS

- 1. Conductor shielding, as provided by a semi-conducting tape over the stranded conductors, excludes air pockets between conductor and insulation and eliminates possible internal corona-cutting of the insulation.
- and metallic shielding tape prevents possible ioniza-tion of air spaces and corona at the insulation
- 2. The semi-conducting tope between the insulation grounded when installed, resulting in zero potential to ground at the sheath. It prevents surface discharge or burning, and pro-tects cable from lightning surges. Reduces shock hazard.

RECOMMENDATIONS

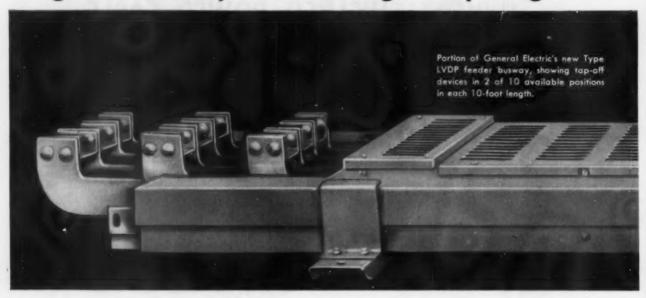
CRESCENT SHIELDED HYVOLT CABLE is recommended for use in conduits, underground ducts, in wet or dry locations, or buried directly in the ground, for circuits operated at over 3000 volts and in accordance with I.P.C.E.A. recommendations. Available in single conductor or multi-conductor cables

Specify CRESCENT SHIELDED HYVOLT POWER CABLE for general power circuits and where severe conditions are prevalent such as chemical plants, refineries, paper mills, mines, sewage disposal plants, etc. It is approved as Airport Lighting Cable Type B, CAA Specification L-824.

CRESCENT INSULATED WIRE & CABLE CO.

TRENTON 5, N. J.

Plug-in Flexibility + Low Voltage Drop + High



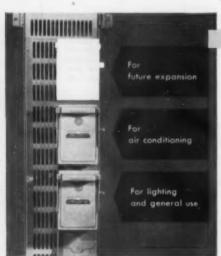
New plug-in busway, with tap-offs at one-foot intervals, carries large blocks of power (600 to 4000 amperes) with virtually no voltage drop penalty!

A major advance in busway design, the LVDP busway lets you \dots

- install a primary feeder system at less cost than ever before
- · lower (and often eliminate) subsequent relocation expense

Industrial plants can now relocate tap-off connections in minutes instead of hours. If equipment such as welders must be moved (no matter how frequently), you merely disconnect your plug and reinsert it at a more convenient place—almost as easily as you do with your toaster at home. You do not have to disassemble and reinstall major busway sections as before.

Commercial buildings are no longer limited to one tap-off per floor. You get the convenience of individual metering for each tenant without adding extra equipment. As requirements grow, you can increase power available to each floor by simply plugging in additional tap-offs.



LOWER INITIAL COST

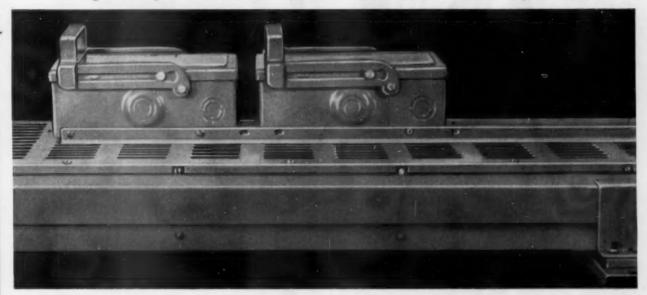
Eliminate hard-to-install cable tap-off box and separate protective device and substitute a simple plug-in combination tap-off and protective device.

LOWER REMODELING COST

Now you can relocate equipment or add new equipment without doing anything more than unplugging the tap-off and reinserting it at a more convenient place.



Capacity-Now in One Feeder Busway!



PLUG-IN FLEXIBILITY: Rated from 600 to 4000 amperes, the Type LVDP plug-in busway comes in ten-foot sections, each with ten tap-off points for subfeeding through standard General Electric Flex-A-Plug* switch units. Outlets are shielded to prevent accidental contact with bus bars.

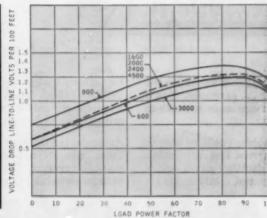
LOW-COST INSTALLATION: LVDP sections match up with G.E.'s Type LVD feeder busway (similar low-voltage drop, same capacity). When plug-in flexibility is desired, use the LVDP. When no taps are needed, you can select lower-cost LVD busway—straight sections, turns and end boxes.

*Registered trade-mark of The General Electric Company

Call your General Electric representative and have him give you all the facts for your next job.

Or write Distribution Assemblies Department, General Electric Company, Plainville, Conn.





Between the point at which power is brought in and the end of the main feeder, voltage drops of eleven percent and more frequently occur, as shown by a recent survey. The chart at left shows the extremely low voltage drop of General Electric's new Type LVDP plug-in busway with aluminum conductors.

Progress Is Our Most Important Product

GENERAL E ELECTRIC



High visibility window . . . easy to read from any angle



Probe jaws fully insulated

reasons

why

you

an

should

choose

AMPROBE



Voltage test leads protected against shorts and shocks



Comes complete with a



Measures current instantly without shutdowns



Beautifully shaped for one hand operation



Dovetail transformer joints



D'Arsonval-jeweled movement



Measures voltage with test leads provided



Covers 6 ammeter ranges and 3 voltmeter ranges



Range switch worked with one finger



A model and a price for every job . . . every budget



Only one-year guarantee offered by any volt-ammeter

Next time you visit your jobber ask to see the Amprobe. Look it over... carefully. You'll find *all* the features that can mean so much to you on the job every day.

Whatever model you choose, you'll be able to measure voltage and current instantly, accurately, safely—without shutting down equipment. Save time, money and costly mistakes by picking up an Amprobe this week for as little as \$19.85. You can get a complete voltammeter for only a few dollars more than an ordinary voltage-tester.

Amprobe is a division of Pyramid Instrument Corp., 630 Merrick Road, Lynbrook, N. Y., manufacturer of REMCON simplified lowvoltage switching devices.

AMPROBE

13 models to make your work easier, faster, surer

There's a model for every job, every budget: from 10 amps and 250 volts to 1200 amps and 600 volts AC; from \$19.85 to \$67.50.

The Finest Products Made with Aluminum

now!

SAVE UP TO 15% with aluminum bus duct

Bus duct distribution systems engineered with Reynolds Aluminum Bus Conductor are now even more economical because of the 15% price differential between aluminum and copper bus duct. And that's only one of the reasons more and more commercial buildings, hotels and large stores are installing this modern method of distributing electrical energy.

Aluminum bus duct distribution systems are also extremely flexible. They're adaptable to horizontal or vertical layouts in small buildings or large. Prefabricated bus duct sections can be extended swiftly in the expansion of electrical systems . . . for lighting improvements . . . air conditioning installations ... and other electrical modernization. Outlets are always easily accessible. In addition bus duct sections are practically 100% salvageable . . . can be removed from existing installations and used elsewhere without appreciable loss of material.

CONTRACTORS: Quote aluminum when you figure bus duct distribution systems. Time and labor savings in installation will permit lower, more competitive bids.

New RABC (Reynolds Aluminum Bus Conductor)

RABC costs less-gives more conductivity per dollar. It's stronger than other aluminum conductors.

It's available in an unlimited range of sizes and shapes. Reynolds does not make bus duct distribution systems, but for more information about their advantages and for names of system manufacturers write Reynolds Metals Company, P.O.

Box 1800-ET, Louisville 1, Ky.

See Reynolds New Program, "CIRCUS BOY", Sundays on NBC-TV

are made with

REYNOLDS 🕮 ALUMINUM



Mr. M., M. Oldman of M. M. Oldman Company, Los Angeles, California

"Day-Brite fixtures save us a lot of time"

Day-Brite A-J hangers ere now furnished in three lengths—8-inch, 12inch and 24-inch. Swivel fitting and over an inch hand-operated vertical adjustment—no field assembly of screws, botts or locknuts required.

"The A-J hanger is one of the best of the many good things we like about Day-Brite fixtures.

"These hangers save a lot of time on the job—particularly on hard-to-work-with and uneven ceilings. Easy adjustment lets us lay in our fixture runs and trim them up later. Adjustable features and different hanger lengths also make A-J hangers good on sloping ceilings.

"So far as our customers are concerned, they're impressed with Day-Brite fixture quality. Everyone knows about Day-Brite—it's a nationally advertised line and that gives us the added prestige that is often valuable in getting jobs where only the best is good enough."

From one end of the country to the other, contractors feel the same as Mr. Oldman. Like him, they know that every Day-Brite job is a real recommendation for the next one.

NATION'S LARGEST MANUFACTURER OF COMMERCIAL AND INDUSTRIAL LIGHTING EQUIPMENT



Day-Brite Lighting, Inc. 5402 Bulwer Avenue St. Louis 7, Missouri



CROUSE-HINDS HANDY GUIDE TO SPECIAL PURPOSE LIGHTING

EXPLOSION-PROOF

DUST-TIGHT

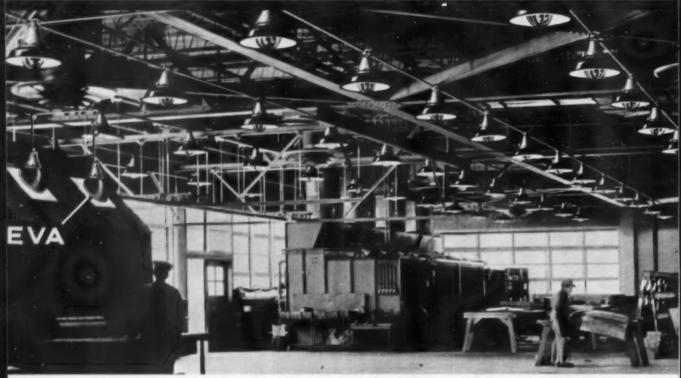
VAPORTIGHT

FLOODLIGHTING

UNDERWATER AND

OTHER SPECIAL APPLICATIONS

CROUSE-HINDS COMPANY



Type EV Explosion-Proof Lighting Fixtures in a painting department

Easiest Installation Easiest Maintenance Highest Efficiency!

You get all three with famous

"EV Series" Explosion-proof LIGHTING FIXTURES

These three features - quickest installation, quickest relamping, more light have made the EV Series the most popular explosion-proof lighting fixtures ever developed! Designed in accordance with UL requirements, they are approved for every Class I location listed as hazardous in the National Electrical Code. You can get one to fit your needs exactly: pendent, ceiling, bracket, or bulkhead - in a wide variety of reflector shapes. Sizes 75W to 500W. Special features available: polished finish, breathers, frosted globes.



al Electrical Code: Class I, Groups C & D











EVA Series with rismatic Holophar Reflector

CROUSE-HINDS SYRACUSE, N.Y.

CROUSE-HIN



EXPLOSION-PROOF LIGHTING FIXTURES

Crouse-Hinds explosion-proof lighting fixtures feature many important benefits: a broad selection, wide enough so you can get approved fixtures of the type you want for *any* hazardous area. Up-to-date, safe, UL-listed designs. The latest improvements in convenience and efficiency.

Only a sampling of Crouse-Hinds explosion-proof lighting fixtures is shown here. See catalog offer at bottom of page for more information.

Vew EVA Explosion-Proof Lighting Fixture — specially designed for hydrogen and acetylene areas.

Now you can make *complete* lighting installations in areas made hazardous by the presence of explosive mixtures of acetylene or hydrogen. Crouse-Hinds makes available *all* the necessary and approved equipment: lighting fixtures, switches, junctions, seals, unions, etc. Gas tightness is not a requirement for safe operation of EVA. Relamp right in the gasladen atmosphere. Sizes: 150W to 300W.

National Electrical Code: Class I, Groups A, B, C & D.



For Fluorescent Installations, Type EVF Explosion-Proof Lighting Fixture



Type RCDE-8 Explosion-Proof Lighting Fixtures

Especially suited to railroad repair pits as well as floodlighting applications—or for flush mountings in suspended or poured ceilings. Available with various style reflectors and lenses. For 100 to 200W lamps.

National Electrical Code: Class I, Group D.

Type RCDE-8 with

Type RCDE-8 for flush ceiling mounting.



NOTE: Other explosion-proof lighting equipment such as floodlights is shown on other pages in this section.

Installation is unusually simple. Can be mounted end to end to provide continuous, uniform illumination. Relamping is quick and easy—no special tools needed. Ballast housing easily accessible. Available with pendent mounting, straight or at 45°. Sizes and styles to take 1, 2, 3 or 4 lamps, 40W to 100W, bipin, rapid start, and slimline types. Also dust-tight.

National Electrical Code: Class 1, Groups C & D

Class II, Groups E, F and G.



Portable Explosion-Proof Hand Lamp

Explosion-proof construction throughout. Thick, impact-resistant globe. Takes 75 or 100W lamps.

Send for Catalog

Our complete line of lighting equipment

is described in this catalog. It's free. You'll find it a helpful guide in your



SYRACUSE, N.Y. CROUSE-HINDS SYRACUSE, N.Y.



Type DLA Dust-Tight Lighting Fixtures installed in a grain elevator.

For Complete Safety In Any Dust-Laden Atmosphere

DL Series DUST-TIGHT Lighting Fixtures

Modern Dust-Tight Incandescent Lighting Fixtures must not only ex-clude dust from fixture interiors; they should also be designed to minimize the accumulation of dust on fixture exteriors, and to operate at temperatures below the ignition point of dust. Crouse-Hinds Dust-Tight Lighting Fixtures meet all these requirements and also provide other important advantages – such as easy installation, attractive appearance, a wide selection of types. Sizes 100 to 500W. Several styles of reflectors available.







DLC Series, Ceiling Type, with flat cone reflector.



DLA Series, Pendent Type.

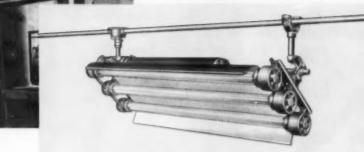


DLB Series, Bracket Type

CROUSE-HINDS SYRACUSE, N.Y. CROUSE-HI



DUST-TIGHT and **VAPORTIGHT** LIGHTING FIXTURES



Type EVF **Dust-Tight Lighting Fixture**

For fluorescent installations. Can be mounted ror nuorescent installations. Can be mounted end to end to provide continuous uniform illumination. Installation is simple. Relamp-ing is quick and easy. Available with pendent mounting, straight or at 45°. Sizes and styles to take 1, 2, 3 or 4 lamps 40W to 100W, bipin, rapid start or slimline types. Also explosion-proof. Dust-Tight. Crouse-Hinds dust-tight lighting fixtures exclude dust from the interior of the fixture. They also dissipate heat rapidly, preventing overheating and ignition of dust which may have accumulated on the exterior.

Vaportight. These fixtures protect lamp, receptacle and the wiring from moisture, gases, vapors, smoke, lint, etc. Used mainly in exposed, damp or dirty locations -- docks, cold storage plants, roundhouses, or shower rooms, for example.



V and VH Series VAPORTIGHT **Lighting Fixtures**

Constructed of tough corrosion-resistant cast Feraloy. Simple in design: wiring chamber remains vaportight, even if globe is broken or removed. Use them to protect your lighting in any wet or corrosive locations. Also suitable for Class III locations (ignitable flyings and fibres). Available with clamp or screw guards, in 11 hub arrangements. Pendent, bracket or ceiling styles. Sizes: 50W through 500W.



National Electrical Code: Class III

Type VDA ew Guard Style

Type VDA mp Guard Style



Portable Vaportight **Hand Lamp**

Handle and globe holder are one-piece moulded Neoprene. Completely vaportight. Sizes for 75W and 100W lamps

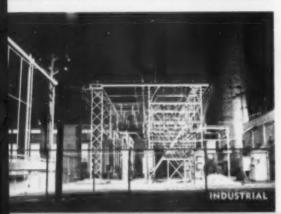
Get your copy of abridged catalog.



SYRACUSE, N.Y. CROUSE-HINDS SYRACUSE, N.Y.







FLOODLIGHTING

From major athletic stadia to parking lots, from petroleum refineries to boxing rings, modern Crouse-Hinds Floodlighting turns night into day. With a type and style floodlight to suit every need, Crouse-Hinds will help you put exactly the right amount of light in exactly the right places.

Our lighting engineers have the broadest experience in Floodlighting. You can get their assistance by send-

> ing a drawing and description of the area you plan to light. We will then submit a complete lighting recommendation, with prices, for your consideration.



HEAVY-DUTY FLOODLIGHTS

Constructed of cast aluminum alloy to withstand rough, rugged duty. They are highly efficient and are available in 12", 14", 16", 20" and 24" lens diameters, from 200W to 2000W lamp sizes. Reflectors and lenses can be varied to provide narrow or wide beams, diffused, concentrated or colored light - or any other combination needed.



FLOODLIGHTS FOR UNDERWATER USE

Crouse-Hinds Underwater Floodlights are of the dry niche type. Both styles are available with or without tile masks. Type RPS can be relamped from pool edge.



CROUSE-HINDS SYRACUSE, N.Y. CROUSE-HIN



Widely acknowledged as the finest.

TYPE FLA FLOODLIGHT

Especially suited to sportslighting

Easier to install, aim, maintain, relamp. Higher efficiency. Permanently weathertight. Pre-wired. Corrosion-resistant. Heat-tempered lens. Available in five beam spreads. Nontarnishing Alzak reflectors. These are some of the reasons why the FLA is the most popular Floodlight available anywhere. Type FLA has found special favor in sportslighting. Gives more light at lower cost with less maintenance for a longer period. You name the sport and FLA will light it . . . better. Lamp sizes 750W to 1500W. Ask for Sportslighting bulletin 2605.

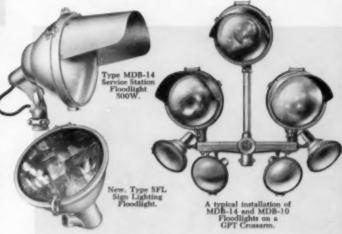
General Purpose Floodlights

Available in an amazing variety of sizes, types and prices. There are simple porcelain-enameled open styles, low-cost sheet aluminum styles, lightweight weather-proof hinged-door styles . . . and so on. Get exactly what you want from the many types of reflectors, mountings, lenses and beam spreads offered.



For Modern **Service Station Lighting**

Crouse-Hinds offers several floodlights especially designed for service station use. No matter what the lighting problem - driveways, signs, or buildings - you'll find Crouse-Hinds equipment to do the job. The details, plus lighting diagrams, are in Bulletin 2689. Write for a copy.





e RCDER-6



Type RLEE



Type ADR Portable Floodlight. Especially adapted to emergency portable use. 250W to 1000W.



Type MDS High Bay Lighting Fix-ture. Widely used for tennis courts,





LITERATURE AVAILABLE. We will send you catalog information on any Crouse-Hinds Floodlights. Simply tell us which type interests you.

SYRACUSE, N.Y. CROUSE-HINDS SYRACUSE, N.Y.

You can get other Crouse-Hinds lighting for almost any application!

The special purpose lighting equipment shown in the preceding pages is only part of the wide selection available. You can fill nearly every special lighting need - even including such unusual items as Explosion-Proof X-Ray Film Illuminators or

Explosion-Proof Exit Signs. Crouse-Hinds lighting equipment is used in an almost limitless number of different applications and locations. Make your selections with confidence. You get the best when it's Crouse-Hinds.



Type VCD-12 For roadways, tunnels, bridges, etc.







Type PLB
For fences and other areas requiring extremely wide beam.



Omamental floodlights.

LET US HELP YOU

WITH YOUR Problem

Crouse-Hinds long experience in special-purpose lighting is unmatched elsewhere. It is available to you without charge

See your Crouse-Hinds distributor. He can help you make the proper selection to fit the job.

Or, you may prefer to contact the nearest Crouse-Hinds office below. Our representatives are electrical engineers. fully qualified to help with Crouse-Hinds product application.

Either way, you'll get all the information you need on Crouse-Hinds products. Not only on lighting fixtures, but also on the 15,000 switches, plugs and receptacles, motor controls, junctions, conduit fittings, etc. which make up the complete Crouse-Hinds Condulet line. A complete Condulet catalog is yours for the asking.



DISTRIBUTION BLUCTRICAL

OUSE-HIN

There's on experienced product engineer ready to help you, at the nearest Crouse-Hinds office. Call: Ermiogham, Indianapolis Canoon Buttolo Chicago Cincinnati Cleveland Cappa Christi Dulba Danver Devindt Historio St. Louis St. Paul Santon Portland, Ore. St. Louis St. Paul Santon Buttoner Button Resident Publication Product Advantage Button Resident Representatives Allowy Advanta Buttonere Button Resident Representatives Allows Advantage of Canada, Ltd., Toronto, Ont.

Charlespoor Jackson ville Beading. Pa. Sickmond, Vo. Shrevpoor Crouse-Hinds Company of Canada. Ltd., Toronto, Ont.

FLOODLIGHTS

CONDULETS

TRAFFIC SIGNALS

AIRPORT LIGHTING



This G-E development engineer is testing a ballast design for a new fluorescent application. He's a member of the largest ballast development group

in the industry. The fundamental research which they perform is one important reason why G.E. is the leading supplier of fluorescent ballasts.

Flora* shows you how . . .

General Electric Ballast Design Leadership Helps You Save Lighting Dollars

General Electric's design leadership has contributed greatly to the vast fund of knowledge now available and being used by the entire ballast industry.

A recognized pioneer in ballast design, G.E. has led in these important developments: Tulamp lead-lag, certified series 96T12, trigger start, rapid start, clamped core, plastic sign, and dimming ballasts. G.E. emphasizes product leadership to provide the best bal-

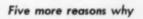
last value to the user. We have never resorted to the temptation of lowering product quality to gain competitive advantage. Instead, we furnish only the best ballasts to assure economical fluorescent lighting. We're convinced there is no substitute for satisfactory performance.

To be sure of top quality ballasts with the latest design developments, look to the leader . . . General Electric!

The next time you specify equipment for a fluorescent lighting installation, make sure you get the best . . . specify General Electric ballasts.

A G-E ballast tag or sticker on your fixture is proof that it's equipped with the best in ballast value. It's the only way to be certain. For further information on G-E ballasts, write Section 401-15, General Electric Co., Schenectady 5, New York.

*Miss Fluorescent Ballast, G. E.'s Ballast Mascat Copyright 1955, General Electric Campany



GENERAL ELECTRIC IS YOUR BEST BALLAST VALUE

- EXCLUSIVE SOUND RATING SYSTEM
- . SUPERIOR QUALITY CONTROL
- LONGER BALLAST LIFE
- PRECISE LAMP-MATCHED DESIGN
- COMPLETE CUSTOMER SERVICES



APLETE CUSTOMER SERVICES

Progress Is Our Most Important Product

GENERAL 🚳 ELECTRIC



USER SATISFACTION gets feremost consideration by G-E ballast development engineers. Here a ballast is being checked to make sure it will provide optimum light output and lamp life.



Long electrical feeders were needed to serve building's rambling wings and 11-story tower, thus making higher-voltage system ideal.

Higher-voltage General Electric distribution



G-E ENGINEERING SERVICE helped throughout the building project, from early planning to start-up. Here, G-E sales engineer, G.E. Troyak (standing) confers with J. F. Hegberg, assistant manager—building service; N. K. Knafla, chief electrical engineer of Magney Tusler & Setter, architects and engineers; and A. S. Ingebredsen of Electric Repair & Construction Co., electrical contractors.

Planners use 480Y/277-volt savings to provide liberal capacity for future loads

Featuring high-level lighting, year-round air conditioning, banks of business machines, escalators, and elevators, the new North Central Home Office Building of the Prudential Insurance Co. has an average of almost 10 volt-amps of electrical load for each square foot of the 292,000 square feet of floor space. In spite of this dense load, Prudential was able to save money on the vital power distribution system serving its Minneapolis building.

SAVING WAS MADE POSSIBLE by using a 480Y/277-volt distribution system to serve most of load. It would have cost about \$50,000 more for a comparable system with 120/208Y volts. The present system has liberal capacity already designed-in to accommodate future increases in electrical demand. Also, to assure reliability, it has two primary power sources, with equipment to switch automatically from one to the other in emergencies.

Key to economies of this system is that the higher the secondary voltage, the lower the current for a





SYSTEM PROTECTION and control at dual 13.8-kv service entrance is provided by highly reliable G-E metal-clad switchgear. Equipment automatically switches load from one line to the other in case of power failure.



EXTRA RELIABILITY of double-ended G-E substation supplying 480Y/277 volts helps assure power continuity. Either transformer can maintain all vital building services.



NECESSARY 120-V POWER for incandescent lights, and business machines is supplied by compact G-E unit substation with electrically operated circuit breakers. Drawout breakers facilitate cleaning and inspection of units.



WELL-LIGHTED offices use standard General Electric fluorescent lamps with G-E 265-v ballasts operating off 277-v circuits to maintain design illumination of 40 foot-candles.

system saves Prudential estimated \$50,000

given kva load. Lower current-carrying requirements mean conductors, such as cable and bus, can be smaller or fewer in number, and circuit breakers can handle higher loads. Other savings come from 440-v motors and control, and reduced voltage drop.

THREE CRITERIA governing applicability of 480-volt system to specific buildings are: (1) load make-up—at least one third of load must use 480 or 277 volts; (2) load magnitude—total load must be at least 200 kva with primary service, 1000 kva when served from secondary network; (3) length of risers and feeders—if these average 200 feet, system will be economical regardless of (1) above.

This system can pay off for you too, and so can General Electric engineering assistance available to you with General Electric equipment. Contact your nearest G-E Apparatus Sales Office for full details or mail coupon at right. General Electric Co., Schenectady 5, N. Y.

JUST RELEASED: A More Power to America film program on power distribution for commercial buildings. Featuring an informative full-color film, "The Tenant at 1010 Main," the program portrays the benefits of an adout system and 480-volt distribution. Ask your G-E Representative about it or mail coupon.

Engineered Electrical Systems for Commercial Buildings

GENERAL 🍪 ELECTRIC

FOR MORE INFORMATION MAIL COUPON TODAY

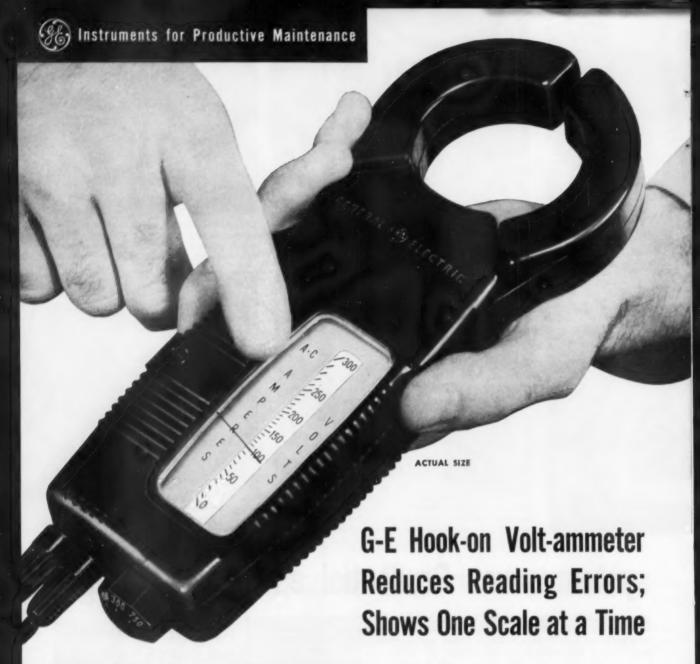
GENERAL ELECTRIC CO. SECTION D680-3 SCHENECTADY S, N. Y.

Please send me:

- "Modern 480Y/277-volt Power Distribution Planning Guide" (GEA-6344)
- "Modern Distribution Equipment for Commercial Buildings in Secondary Network Areas" (GEA-6223)

I am also interested in \square borrowing, \square purchasing "The Tenant at 1010 Main," 33-minute, color, motion picture.

POSITION COMPANY
ADDRESS
CITY. STATE



GENERAL ELECTRIC'S hook-on volt-ammeter shows only one scale at a time. You simply select the desired range and only the corresponding scale is visible. This eliminates the possibility of reading the wrong scale, as can be done with multiple scale face instruments. The range and scale of this G-E instrument are changed simultaneously by turning the finger-tip control knob. The two models of the instrument are designated Types AK-4 and AK-5, and both have current scales marked in black and voltage scales marked in red.

USED BY contractors, electricians, engineers, maintenance and servicemen, the G-E hook-on is ideal for

balancing circuits and tracing faults and grounds without shutting down equipment.

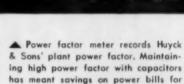
WIDE RANGES are available in both models of the G-E volt-ammeter. Ranges of the AK-4 model are 0-10/30/100/300/800 amperes and 0-150/300/750 volts. The AK-5 ranges are 0-5/20/80/350 amperes and 0-150/300/750 volts. The wider range AK-4 model has a pointer-stop to check surge readings.

FOR FURTHER INFORMATION, write section 582-10, General Electric Co., Schenectady 5, New York and ask for bulletin GEA-6292, or contact your nearest G-E Apparatus Sales Office.

Progress Is Our Most Important Product

GENERAL BELECTRIC





25 years at the Rensselaer plant.

 ↓ James G. Armstead, maintenance engineer, and T. R. Butman, electrical foreman, inspect G-E capacitors installed at Huyck & Sons in 1931.

Since 1931 General Electric capacitors have saved money for F. C. Huyck & Sons

That's what James G. Armstead, maintenance engineer at F. C. Huyck & Sons, Rensselaer, N. Y., says about the first General Electric 5-kvar Pyranol* capacitors ever installed. According to Mr. Armstead, "These capacitors have been saving us money for 25 years."

In February 1931, F. C. Huyck & Sons, manufacturers of papermaker's felts and engineered fabrics for industry, installed 90 General Electric capacitors to improve power factor and increase system efficiency. To keep pace with increasing production, Huyck & Sons later added more G-E capacitors; their system now includes approximately 750 capacitor kvar.

The result of these capacitor applications has been an average plant power factor of 94 percent. Since Huyck & Sons has a kvar demand clause in its electric utility contract, this high power factor has meant monthly savings on power bills.

Mr. Armstead also pointed out the long life of the General Electric capacitors.

"We set up our equipment depreciation on a 20-year basis,"

he said. "These capacitors are now saving us even more money."

Even the original capacitors, during 25 years of service, have required very little maintenance. According to Mr. Armstead, "We inspect them from time to time to check the fuses—otherwise they just sit and save."

Perhaps capacitors can sit and save for you, too. If you use induction motors, check your power factor—or ask your G-E sales engineer to do it for you. Then check your utility power contract to see how much you will save by raising your power factor. You will be able to determine in advance how much you will save on power bills by installing capacitors. For more information on industrial power capacitors, write for bulletin GEA-5632, "How to Use Capacitors." General Electric Company, Section 441-43, Schenectady, N. Y.

*Registered trademark of General Electric Co.

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GENERAL 🍪 ELECTRIC

G-E MANUAL STARTERS . . .

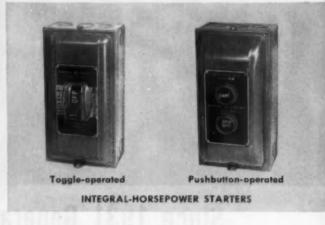


INTEGRAL-HORSEPOWER manual starter used to control a grinder. For dependable protection, toggle-switch and push-button forms give visible indication of overload and are trip-free.

SPECIAL COMBINATIONS of fractional-horsepower starters provide a wide selection for your applications. Here two forms of the CR1061 are used in a heating and grinding application.

When you need low-cost motor control for motors up to $7\frac{1}{2}$ horsepower, be sure to specify General Electric manual starters. Economical to buy, G-E manual starters reduce installation time and lower your installation costs.

EASY MOUNTING is one of the installation features of manual starters. The CR1061 fractional-horsepower starter can be mounted on or beside the machine, and no accessories are required. A maximum of four screws are required to mount the starter.



VERSATILE G-E RELAYS

The small, general-purpose relay, CR2790, is adaptable to applications with a maximum of four circuits. It can be used for lighting and air conditioning loads, as a control relay, and as a fractional-horsepower motor starter for small pumps and fans if overload protection is provided

elsewhere.

A flexible shunt withstands vibration and adds to long relay life. Silver contacts provide dependable make-and-break. Relay accessories provide for back-mounting, plug-in operation, and for use in dusty and hazardous locations.

For more information on the generalpurpose relay, write for bulletin GEC-257.



Economical to Buy-Faster to Install

The CR1062 starter for integral-horsepower motors up to $7\frac{1}{2}$ horsepower is also easily mounted. There is a keyhole slot at the top of the enclosure, which supports the starter while the two bottom screws are inserted and tightened.

WIRING IS SIMPLIFIED in all G-E manual starters. Knockouts on the top, bottom and sides allow the best wiring arrangement for the application. Large easily reached terminals simplify the wiring, which

is all connected from the front. Front connection is especially valuable when you want to mount starters side by side to save space.

YOUR CUSTOMERS will also like the General Electric manual starters. All starters have silver contacts, quick breaking switch mechanisms, and bi-metallic overload relays, for long dependable operation. For more information on manual starters, write for bulletin GEA-6358.



Toggle-operated



Starter and Selector Switch



Starter and Indicating Light



Two Starters

MEAN OFF-THE-SHELF SERVICE

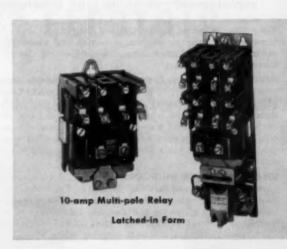
Versatile G-E 10-amp multi-pole relays give you offthe-shelf service for many applications. Relay forms available include two through eight poles. Contacts change from normally open to normally closed without any tools or additional parts.

FRONT-MOUNTED, sturdy terminals are easily accessible for front wiring, even when the device is mounted in an enclosure.

Another form of the relay includes a latched-in mechanism for maintaining sequence continuity in the event of power failure, or where extremely quiet operation is required.

A modification kit is available to convert a 10-amp multi-pole relay to a latched-in relay. All parts are included in the kit, and are easily added to the bottom of the relay with a screwdriver.

For more information on the latched-in form, write for bulletin GEC-1281.



For further information, contact your G-E Apparatus Distributor, or write Section 733-6.

FRACTIONAL-HORSEPOWER STARTERS

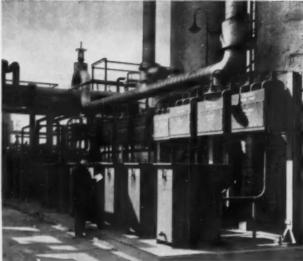


BLOOMINGTON, ILLINOIS



COMPLETE LINE of G-E oil-filled cutouts includes pole, pothead and subway types and metal-enclosed assemblies.





INDUSTRIALS, such as this oil refinery, use these three-phase metalenclosed G-E oil-filled cutout assemblies to protect equipment.

UTILITIES with underground systems use G-E oil-filled subway-type cutouts for single phase or three phase, gang-operated, fusing or switching. Expansion chambers are required to secure full interrupting rating.

For best in low-cost switching...industrials, electric utilities choose G-E oil-filled cutouts

Indoors or outdoors, they permit substantial savings on first cost and fuse replacement—combine high interrupting capacity, safer operation and long life

For utility, industrial, commercial and institutional applications that combine overcurrent protection and load-break switching, more and more companies are choosing General Electric oil filled cutouts.

HERE'S WHY: Low-cost G-E oil-filled cutouts provide high interrupting capacity . . . up to 11,000 rms amperes. They provide for maximum safety of personnel . . . all arcing occurs under oil and all flame, noise and electrically live parts are confined within a metal housing. And G-E oil-filled cutouts offer long service life since interrupting ratings are based on test conditions far more severe than those normally encountered in operation.

IDEAL INDOORS OR OUTDOORS G-E oil-filled cutouts are quiet in operation, and they may be wall or direct-to-equipment mounted. Single- or three-phase metal-enclosed assemblies provide for all wiring and electrical connections to be completely enclosed in a grounded steel cabinet. Entrances can be provided for connection to outgoing cables.

Other G-E oil-filled cutout features include:

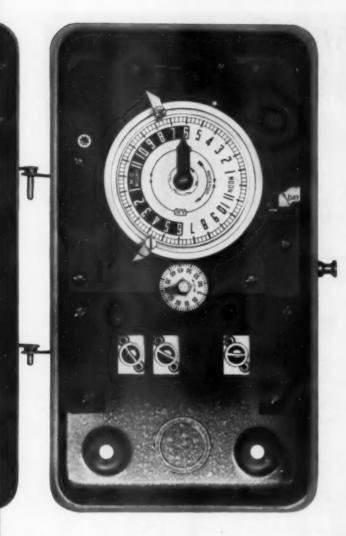
- Simple fusing, even on gang-operated assemblies. Preformed fuse links easily slip into place.
- Silver-plated self-aligning contacts of heavy forged copper with special arcing tips . . . minimize wear.
- Leads brought into cutout housing above oil level—no gasketed joints under oil pressure.
- Pole and pothead types do not require expansion chamber for full interrupting capacity.

If you have an application that requires overcurrent protection *plus* load-break switching, it will pay you to investigate G-E oil-filled cutouts. Available for 2400-, 4330- and 7200-volt circuits, they can mean substantial savings in initial costs and fuse replacements.

For complete information, contact your nearest G-E Apparatus Sales Representative, or write for bulletin GEC-863, General Electric Company, Schenectady 5, N. Y. 433-12

Progress Is Our Most Important Product

GENERAL & ELECTRIC



New General Electric TSA-40 Time Switch At a New Low Price

Now you can get reliability at low cost for any ON-OFF job

The TSA-40 is a completely new heavy duty time switch engineered by General Electric to give you more reliable on-off operation at a lower price.

HIGH RELIABILITY of the G-E TSA-40 time switch is made possible by the exclusive contact shearing action, the one-piece terminals and contact blades, and the time-proven Telechron* motor. Now with weatherproof case, the TSA-40 is fully suitable for all types of ON-OFF applications, indoor and outdoor, in temperatures from -50 F to 150 F.

LOW COST means you get this reliability in the TSA-40 at prices starting as low as \$22.70**. Not only this, but highly dependable operation means minimum attention, and you save money on maintenance. For off-the-shelf delivery contact your local General Electric time switch distributor or the G-E Apparatus Sales Office nearest you today. Or write for free bulletin to Section 584-5, General Electric Co., Schenectady 5, N. Y.

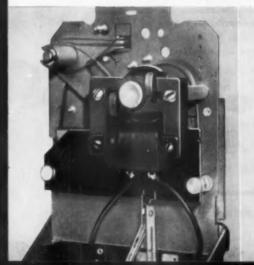
*Reg. trademark of General Electric Co.
**Manufacturer's suggested resale price for standard SPST model.

GENERAL 28



ELECTRIC

GREATER TEMPERATURE RANGE of -50 F to 150 F is made possible by improved Telechron® motor. Direct drive of switching mechanism assures positive action. COMPLETELY WEATHERPROOF steel case has press-fit latch for tight seel and easy opening. Side-hinged removable cover simplifies installation and maintenance. NO WIRING BURNOUTS or "hot spots" because one-piece contact and ferminal assembly eliminates all internal wiring to contacts. Unit terminal block makes replacement easy.







Only amplex Swivelites Only amplex Swivelites Give You These 4 Big Selling Features

1. DOUBLE-BALL SWIVEL

Exclusive free-floating universal joint swivel. Just a touch of the finger gives your customers positive positioning to any angle – 360° horizontal and 170° vertical. No set screws or wing nuts to adjust.



2. LUSTROUS, LASTING FINISH

Deluxe Satin Aluminum, infra-red baked to give your customers lasting satisfaction. Won't chip, discolor or blister from heat—even after long service.



3. AIR FLOW VENTILATION

8 ventilating ports in base of Swivelite hoods carry off excess heat. Lamps burn cooler, last longer. Far less tendency for lamp bulb bases to loosen in service.



4. "ADAPT-A-UNIT" CONSTRUCTION

It's a snap for you to adapt the original installation to changing needs of your customers. Add, remove or interchange hoods; install Add-a-Pipe, Add-a-Flextension or Curved Arm Pipe Lengths as needed.

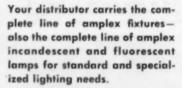


And Recommend these amplex Fixtures Too



FOCALITES

with tripod base or canopy mounting for a host of accent lighting purposes – floor and window displays, show cases, shadow boxes, niches.



For descriptive literature, write

1

RECESSED HI-HATS

For recessed lighting installations. Heavy gauge aluminum with standard steel knockout boxes attached. Available with pre-wire assemblies for easy mounting.

amplex

C O R P O R A T I O N

Dept. ECM-1056

1 1 1 W A T E R S T R E E T

B R O O K L Y N 1, N. Y.

See What Square D's Front-Connected **POWER-STYLE** Switchboards Offer!

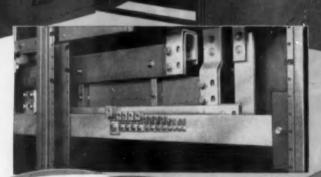


First completely standardized switchboard built specifically for small and medium-size installations. Bus bars designed to assure cool operation in a depth of 14 inches!

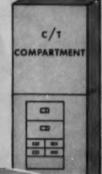
Complete front accessibility allows all bus bars and branch circuit connections to be installed and removed from the front! Permits mounting directly against wall.

Off-center mounting of breakers (or QMB fusible switches) in right hand section provides maximum room for installing cables from larger units.

Standardized C/T compartment built to meet Edison Electric Institute and Public Utilities' specifications.



Completely standardized horizontal bussing is available up to 2000 amperes, at either top or bottom. Notice bus bar drillings for extension to future sections.



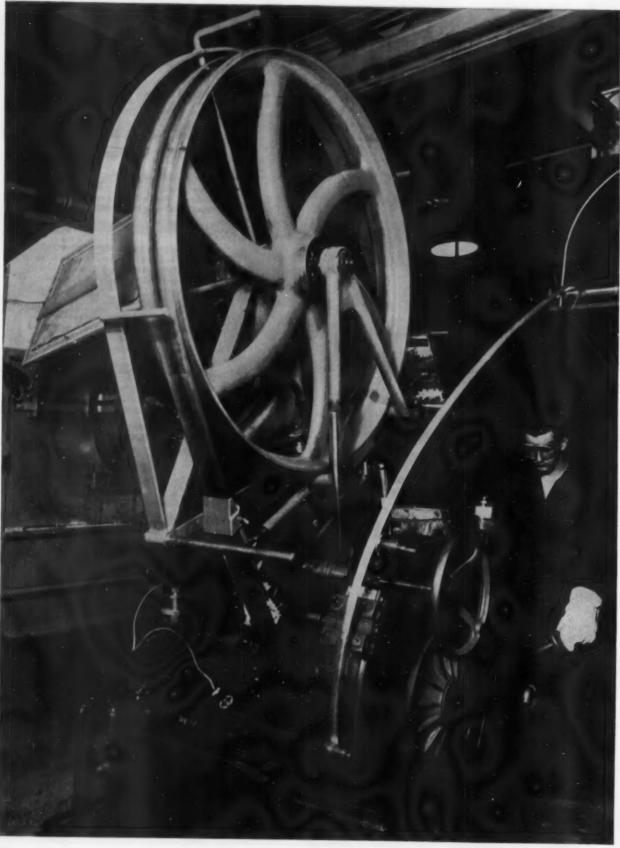
Standardized C/T compartment designed to provide most flexible arrangement. Available in either "hot"or "cold" sequence, top or bottom feed. When used without main disconnect in "hot" sequence, up to six subdivisions can be mounted in same section with C/T compartment.

Write for descriptive bulletin

Address Square D Company, 6060 Rivard Street, Detroit 11, Michigan



SQUARE D COMPANY



52

ELECTRICAL CONSTRUCTION AND MAINTENANCE . . . OCTOBER, 1956

Properzi Process

Starting point of Rome aluminum wires and cables that save on costs

First we feed EC grade molten aluminum into a finely machined groove in the Properzi casting wheel.

A special steel band completes the mold and holds the molten aluminum in the groove of the slowly turning wheel. In seconds, a continuous length of triangular casting emerges. It is very uniform—both physically and metallurgically.

From that uniform casting, we make aluminum wires and cables to meet practically any requirements. To the casting and subsequent processing of the aluminum, we add years of cable making "knowhow" and experience gained from years of chemical research and development with insulating and sheathing compounds.

Savings possible

In many cases you can save with Rome aluminum wires and cables three ways:

- 1. Lower initial costs.
- Lower installation cost. Since aluminum is lighter than copper cable, you can use longer spans, fewer poles, less hardware.
- Lower maintenance cost in overhead line installations. Rome aluminum wires and cables have maximum resistance to storms, ice loading, etc.

Popular types

Below are three popular types of Rome aluminum wires and cables. We can make other constructions of aluminum, ACSR, and aluminum and copper or Copperweld combinations to meet requirements.

Rome aluminum lindwire

RoPrene (Neoprene) or RoLene (polyethylene) line wire. Write for Bulletins WP-2A and WP-4.



Rome aluminum power cable

RoZone-A (butyl base), RoZone (oil base), or Ro-Marine (RH-RW) insulation with RoPrene sheath. Write for Rome Power and Control Cable Catalog PC-1 for further details.



Rome aluminum triplex

Self-supporting secondary and service drop cable. RoPrene (Neoprene) or RoLene (polyethylene) insulation with ACSR or other suitable bare neutral messenger. Write for Bulletin RS-5 for details.



ALUMINUM

Rome Cable Corporation, Rome, New York, and Torrance, California

This is the radiant heating panel backed by the PYREX trademark

And it's the only glass panel with a one-year warranty

You can rely on the proven dependability of this low-temperature source panel to increase your electric home heat installations.

Every Pyrex panel is warranted by Corning Glass Works for one full year. If, during the first year of service, a panel fails due to a defect in the glass panel, Corning will replace the panel at no cost to the manufacturer.

You can recommend and install the Pyrex brand glass panel confidently.

High wattage output

Because Pyrex radiant panels are tempered borosilicate glass, they pack more watts per unit. One Pyrex unit, for example, gives you up to 3,000 watts output in permanent installation heaters. And tempering further increases resistance to thermal shock and mechanical impacts.

With this panel, you lower the initial cost of an electrical heating system and you reduce installation costs, as well.

Full radiation

The entire back surface of the PYREX panel is coated with an electrically conductive metallic deposit. Thus, the



entire panel area radiates long-wavelength infrared rays.

With the PYREX panel you get lower operating costs than with other, less efficient elements. There is no heavy starting surge.

Send for full information

The Pyrex panel is available to you now with years of satisfactory performance behind it. Homeowners are using it in built-in systems and in portable units.

If you are in one of the growing number of areas served by utilities anxious to increase electric heating to balance their winter-summer loads, this panel can be of profitable help to you. To find out how, write, wire or phone us.



Wall-mounted panels by Berko Electric Manufacturing Corp. Easy to install. The baseboard elements use Pyrex panels, too.



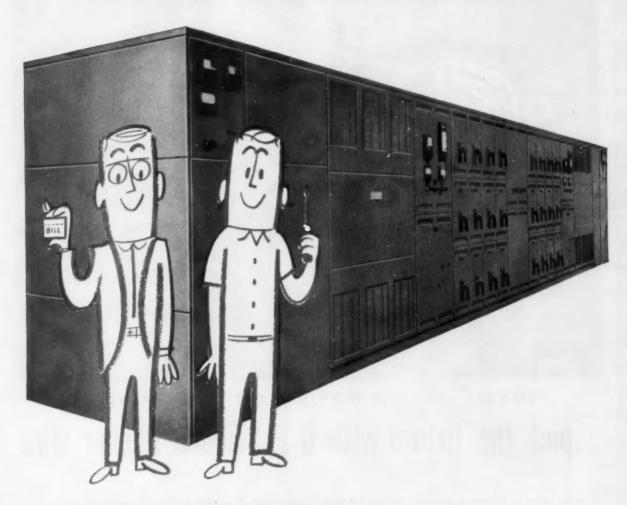


CORNING GLASS WORKS, CORNING, N. Y.

40-10 CRYSTAL STREET

Couning means research in Glass

I-T-E Secondary Unit Substations



... designed and built for economy in installation and operation

I-T-E Secondary Unit Substations bring electric power nearer to where you use it—make it more dependable—save you time and money. They do it in several ways:

- By bringing higher voltages nearer the load and reducing power losses
- By reducing voltage drops inherent in long low-voltage runs and increasing machine efficiency
- * By saving space-all necessary components are housed in one functionally designed unit
- By cutting delivery and installation time—units are assembled, tested and shipped ready for immediate installation from one source of supply
- By protecting plant personnel-all live parts are isolated and metal enclosed

I-T-E Secondary Unit Substations can be supplied for any application indoor or outdoor, and in any standard rating. For complete information, contact your nearest I-T-E sales office. Or write I-T-E Circuit Breaker Company, 19th & Hamilton Sts., Phila. 30, Pa.



1-T-E CIRCUIT BREAKER COMPANY . Switchgear Division



BECAUSE HEAT AND MOISTURE ARE TROUBLEMAKERS

...pick the fixture with G-E Silicone Rubber Wire

A major cause of failure in recessed lighting fixtures has been breakdown of lead wire insulation. Even good fixtures run into this problem because of excessive heat and moisture. G-E silicone rubber fixture wire operates safely at conductor temperatures as high as 200 C. And it has excellent resistance to moisture and heat-aging as well. So, to eliminate callbacks and customer complaints, be sure the next fixtures you buy are equipped with G-E silicone rubber wire.

G-E silicone rubber wire meets the acute demand for fixture wire rated at least 150 C for use in wet locations. Because it is flexible, clean stripping, and easy

to handle, it requires no special installation techniques. (Listed by Underwriters' Laboratories, Inc.)

FOR COMPLETE SPECIFICATIONS and a sample, write Section W176-1018, Construction Materials Division, General Electric Company, Bridgeport 2, Connecticut.

LOOK FOR THE TAG

The tag shown above may only be displayed on fixtures equipped with General Electric silicone rubber wire. Look for it...it will help you select fixtures that are wired to withstand the effects of heat and moisture.

Progress Is Our Most Important Product

GENERAL 🗱 ELECTRIC

er creative design ability.

AMERICAN PLASTIC LOUVERS

Take advantage of the latest developments in modern lighting design. In American Louvers, total absence of welding, riveting, and surface brightness means exceptional versatility. They may be employed as single, recessed, or surface mounted units, continuous runs, or any combination of modular patterns, including over-all ceilings.

LOUVER

COMPANY

CHICAGO 34, ILLINOIS

One in a series to emphasize the economy of Electrical Wholesale Distribution



recognizing Electrical Distributor serves and saves"

"Electrical Wholesaler Distribution reduces the Manufacturer's selling cost and thereby reduces the selling price of electrical supply material to the user. Therefore, our policy has been to distribute Thomas & Betts products exclusively through the Electrical Wholesaler."*

LOOK FOR THIS SIGN



IT'S THE MARK OF AN AUTHORIZED T& B DISTRIBUTOR

THE THOMAS & BETTS CO.

INCORPORATED 34 BUTLER STREET, ELIZABETH 1, NEW JERSEY THOMAS & BETTS, LTD., MONTREAL, P. Q., CANADA MANUFACTURERS OF FINE ELECTRICAL FITTINGS SINCE 1898

*Quoted from the T & B Plan of Wholesaler Distribution. If you would like to know the complete story of the T & B Plan, write: TRIANGLE multiple product Job

Everything's BIG in Texas and now Houston has added another BIG \$17,000,000 Building of Bank of the Southwest Opens Its Doors

2,103,500' of TRIANGLE WIRE AND CABLE 322,580' of TRIANGLE CONDUIT



That's how much top-quality Triangle footage went into the building. A sizeable order, by any standards, and delivered on time.

Triangle Distributors are able to meet deadlines on big orders like this because Triangle's 100% distributor policy means production is geared to distributors' needs, assuring them of ample stocks to meet heavy delivery schedules and emergencies.

And every foot of Triangle material is top-quality because Triangle's manufacturing plants are equipped with the most modern production machinery and laboratory facilities available . . . operated by men who know their jobs.

That's why those who know, specify TRIANGLE IT MUST BE RIGHT

Let's take a Quick Look at TRIANGLE

Bank of the Southweat. Its lobby, 63,000 square feet, is the largest in America. This ultra-modern building covers an acre and a half and rises 24 stories. The entire building is air conditioned by the largest electroni-cally controlled system in the country. ARCHITECT: Kenneth Franzheim ENGINEER: H. E. Bovay (mechanical and electrical) GENERAL CONTRACTOR: W. S. Bellows ELECTRICAL CONTRACTOR: Flak Elec-tric Co.



The Triangle Trademark is your guarantee of quality Ever expanding plants

RIANGLE

Conduit and Cable Co., Inc.



What you don't see in this modernly-styled Levolier® industrial lampholder is as important as its attractive lines. Built to eliminate replacement, the lampholder cap and casing is double thick impact-resisting molded pheno-lic. The screw shell inside is .006" heavier than standard. The housing, which screws together at the lever, encloses the proven Levolier® switch-mechanism with either push button action or universal lever control. Mod-els include 1/4", 1/4" and pendant caps.

150-CA

THE SAFE WAY

to change lamp bulbs

is with MGILL adaptable

lamp changers

You keep your feet on the ground even

when you're changing lamp bulbs up to

30 feet above the floor with the McGill Adaptable Lamp Changer. Lightweight steel pole is furnished in 5' insulated sec-

tions that lock together securely by spring-actuated buttons. Several style heads available for virtually any size,

shape and type of bulb.

install it - forget it



IT'LL LAST A LIFETIME

You have no replacement worries when you use the No. 41 Levolier® switch. It has no match for quality and is so trouble-free and durable it is unconditionally guaranteed against failure. Ideal in any canopy mounting for individual control of fluorescent or incandescent lighting also FHP motors. Its rugged, one-piece molded phenolic case gives better insulation and makes wiring easier. 6 amp, "T" rated, 125 volts. Underwriters' Laboratories approved.

M^cGILL Levolier Switches

only

MEGILL® grounded guards

with the PREFERRED NEW

GROUNDING ARRANGEMENT

* Conform to N. E. C.

- Grounding adopted as standard by American Standard Ass'n.
- ★ Underwriters' Laboratories Inspected

McGill grounded portable lamp guards give you the advantages of the preferred, new grounding arrangementa 3-blade plug and convenience outlet with 2 parallel blades and a U-shaped third blade for ground. These portables will outlast several "inexpensive" portables because all component parts are quality molded phenolic handles cages, electrically welded and zinc plated with bright

heavy steel wire

chromate finish. Levolier switch and keyless types, with or without 16-3 SI black rubber cord.

ECTRICAL SPECIALTIES

are always a little better and ALL are Underwriters' Laboratories Inspected

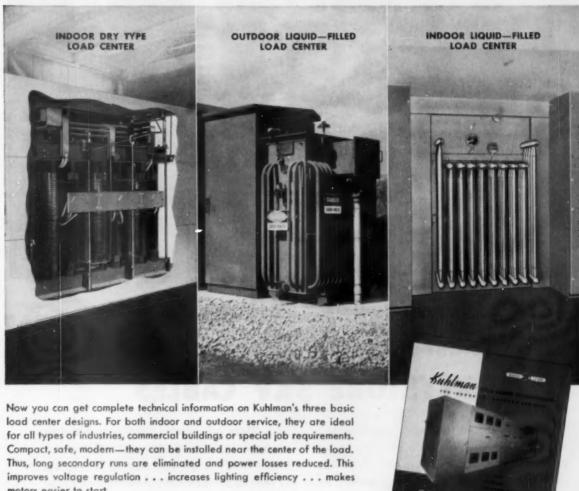


Available through leading Electrical Wholesalars

> for complete information on McGill Blactrical Products, write today for the new Catalog No. 84.

McGILL MANUFACTURING COMPANY, 450 N. Lafayette Street, Valparaiso, Indiana

NEW BULLETIN ON LOAD CENTERS SHOWS 3 WAYS TO REDUCE POWER LOSSES AND LINE DROP



motors easier to start.

Choose the Kuhlman load centers that fit your needs. Standard components provide numerous circuit combinations for either indoor or outdoor installations. This new Kuhlman reference bulletin, CS-1000, will give you all the facts. Get your copy—simply send the coupon below.

KUHLMAN

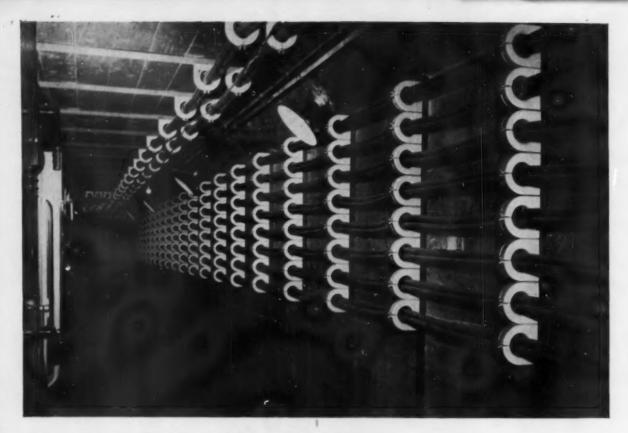
ELECTRIC COMPANY

KUHLMAN I	ELECTRIC CO1001 26th StBay City, Mich.
Gentlemen:	Please send me the new bulletin, CS-1000, on Kuhlman Load Center Transformers.
**	
Name	
Title	
Title	

BAY CITY, MICHIGAN

CRYSTAL SPRINGS, MISSISSIPPI

SALINAS, CALIFORNIA



for maximum dependability... world's most modern shell plant specifies **KEYSTONE 5KV CABLES**

Nothing was spared to provide the surest and most adequate supply of electrical energy for the huge motors, pumps and other equipment that make the Scranton Ordnance Plant, operated by the United States Hoffman Machinery Corporation, the largest and most modern of its type in the world.

In production less than 18 months after the project was approved, the plant makes extensive use of Keystone insulated 5kv non-shielded cable.

A typical application of this top-quality, yet economical cable is found in the plant's forge shop. There, 1/conductor 750,000 cm Keystone insulated 5kv non-shielded cables feed power from 3-5000 kva transformers to 12-600 hp and 12 - 450 hp pumps which provide hydraulic pressure for the main drawing and forging operations. These dependable power feeder cables are installed in interconnecting underfloor tunnels like the one shown above.

You, too, can use Keystone cables to advantage in your operation. Ask for Bulletin EC-463 for full details or write The Okonite Company. Passaic, N. J.

2954-A

Available with either copper or aluminum conductors



where there's electrical power . . . there's OKONITE CABLE

Totally Enclosed Class H Insulation

-at no extra

ALLIS-CHALMERS

Dry-Type transformers

Porget all about maintenance with this Allis-Chalmers totally enclosed, 150 C rise, drytype transformer. No dirt, dust, moisture or lint can get at it. Use it indoors or outdoors. It is completely weatherproof.

Class H insulation used throughout the coil structure results in long insulation life. Case temperatures are low—do not exceed maximum of 40 C rise. All safety requirements are easily met. No vaults or barriers are needed.

Modern design features result in a compact, convenient transformer that will give years of satisfactory operating life. All these advantages are available at no extra cost.

For Complete Information, call your nearby Allis-Chalmers district office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wis.

Coil has maximum insulation life with Class H (150 C rise) insulating materials.

2

Simple, sturdy, totally enclosed weatherproof case has just one welded seam. 3

Recessed bottom plate has eight bolts for positive closure, yet gives quick accessibility.



ALLIS-CHALMERS



Remote or automatic switching

AT HALF THE COST

with Westinghouse motoroperated AB circuit breakers

Now you can use a pushbutton or relay to electrically operate a Westinghouse AB circuit breaker. You can add load switching to your circuit protection — from a convenient point or under pre-determined conditions. And all without the need for a costly breaker-contactor combination or an expensive, large air circuit breaker.

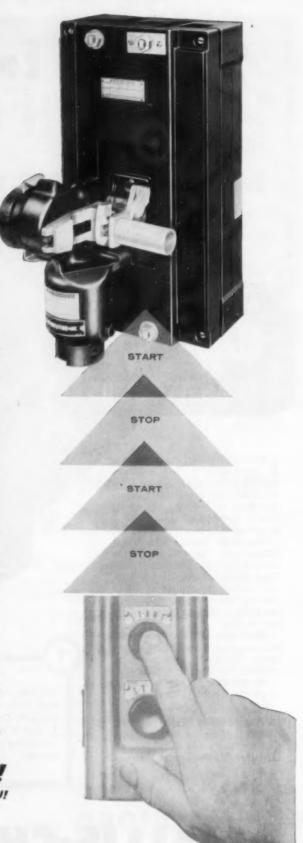
Cost of the motor operator is but a small fraction of that for a large contactor. In fact, the complete dualpurpose breaker (breaker and motor operator) cost less than a contactor alone. Don't forget either the valuable space you save by eliminating contactors or by replacing larger breakers.

With the Westinghouse motor-operated circuit breaker you get all the proved AB De-ion® protection features. In addition you have your choice of such internal aids as reverse-current trips, undervoltage trips, and auxiliary or alarm switches. The motor operator can be applied to breaker Types J, K, KL, L and M in ratings of 70 through 800 amperes.

If it's remote or automatic breaker switching you need, consider the real savings possible with motor-operated AB circuit breakers. Your local Westinghouse sales office will be glad to help — or write direct to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

WATCH WESTINGHOUSE!

WHERE BIG THINGS ARE HAPPENING FOR YOU!



Holiday

STREET LIGHTING

WITH

UNION PIN-TYPE SOCKETS

TIME PROVEN-TIME SAVING

Supplied with hand wrenches for onthe-job assembly. Available on streamers or in stars for large installations.

Depend on UNION for quickest (same day) delivery and unsurpassed quality to insure your profits.

Sold through preferred distributors everywhere.

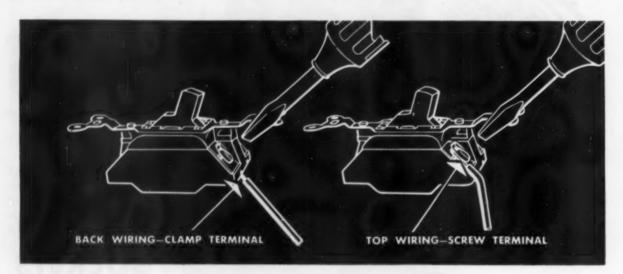


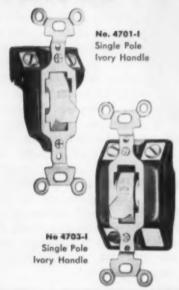
UNION INSULATING CO.
Parkersburg, West Virginia

NEW DESIGN

BRYANT SILENT MERCURY SWITCHES

Higher Rating • Optional Wiring • Easier to Install





Control Tungsten Filament or Flourescent Lamp Loads at Full Rated Capacity

HIGHER RATING—15 Ampere 120 Volt A.C. Rating makes this switch particularly desirable for the control of tungsten filament and fluorescent lamp loads without derating. A.C.-D.C. Rating — 10 A. T. 125 V. — 5 A. 250 V.

OPTIONAL WIRING — Either screw terminal top wiring or clamp terminal back wiring.

EASIER TO INSTALL — Unique design permits rapid connections — whether top or back wired.

APPLICATIONS—Especially suited for hospital, residential and other installations where completely silent operation is desired.

AVAILABLE — In single or double pole, 3 and 4 way types with brown or ivory handles.

Listed by Underwriters' Laboratories, Inc. J.99970



THE BRYANT ELECTRIC COMPANY

Bridgeport 2, Connecticut . CHICAGO . LOS ANGELES



WHY CIRCLE CAN "TURN HANDSPRINGS" on shipments needed yesterday!

Your Circle distributor doesn't have to build any fires under us to get fast action on building wire and cable you need in a hurry.

That's because giving this kind of fast service is a basic policy of Circle's—the result of a flexible organization that's out of sympathy with "red tape," "stuffed shirts," and routine treatment of emergency orders.

When a Circle distributor wires or phones to ask for a shipment "needed yesterday," he knows he can get to anyone from the president on down—and get immediate personal attention.

Chances are, however, he rarely finds himself in that kind of a spot. His own ample stocks of top-quality Circle wire and cable are backed by a nearby completely-stocked Circle warehouse—one of twenty-two strategically located across the country.

That is why working through a Circle distributor is always your best assurance of adequate supplies—quickly and dependably delivered to the site. Circle Wire & Cable Corp., 5500 Maspeth Ave., Maspeth, Long Island, N. Y.

Although Circle is one of the country's largest producers of huilding wire and cable, customers can still call headquarters direct for immediate personal attention.



Circle maintains a national network of 22 wellstocked warehouses to help your distributor provide fast local deliveries of top-quality building wire and cable.

wire & Cable

a subsidiary of

Cerro de Pasco

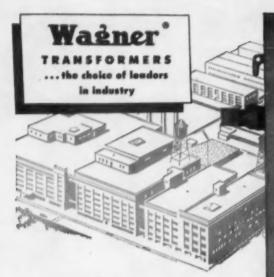
Corporation



CIRCLE

PLANTS: Mospeth and Hicksville, N.Y. SALES OFFICES & WAREHOUSES: Atlanta, Baltimore, Boston, Chicago, Cincinnati, Dallas, Des Moines, Detroit, Houston, Jacksonville, Los Angeles, Miami, Minneapolis, Nashville, New Orleans, Omaha, Philadelphia, Pittsburgh, Portland, Ore., San Francisco, Seattle, St. Louis. ADDITIONAL SALES OFFICES: Cleveland, Davenport, Ia., Newark, New Haven, New York, Utica.

RUBBER COVERED WIRES & CABLES . VARNISHED CAMBRIC CABLES . PLASTIC INSULATED CABLES . NEOPRENE SHEATHED CABLES



PLANNING A NEW LOAD CENTER?

...with the Wagner Close-Coupled Transformer, you can build a compact, modern unit substation

These Unit Substation Transformers save space...make a neat, streamlined installation

Wagner close-coupled, liquid-filled unit substation transformers can be easily flushmounted with co-ordinated switchgear. And when they are, the result is a neat, modern, compact installation that not only saves space in your plant, but looks better too.

You get quicker delivery on a close-coupled Wagner transformer because there are fewer engineering difficulties than with the throatconnected type. It's not necessary to co-ordinate the bushing height of a close-coupled unit to match special switchgear. Bushing heights are designed to give ample room to make connection to switchgear or busses in the switchgear compartment or transition section. No need for special throats to match special switchgear.

Look to Wagner for transformers that assure a continuous dependable flow of power. Your nearby Wagner engineer will be glad to help you solve your load-center problems. Call the nearest of our 32 branch offices or write us.



Wadner Electric Corporation

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

ELECTRIC MOTORS . TRANSFORMERS . INDUSTRIAL BRAKES . AUTOMOTIVE BRAKE SYSTEMS-AIR AND HYDRAULIC



Here are the reasons for this overwhelming preference:

Experience shows that ballasts delivering improper electrical values to tubes may reduce lamp life by as much as 50% and light output as much as 30% below ratings.

To prevent such losses and to provide every possible safeguard, CERTIFIED CBM BALLASTS are made to exacting specifications that prescribe the correct electrical values to be delivered to the tube.

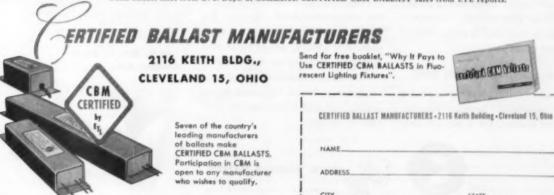
And to assure conformity to these specifications, Electrical Testing Laboratories, Inc., regularly tests samples of factory production.

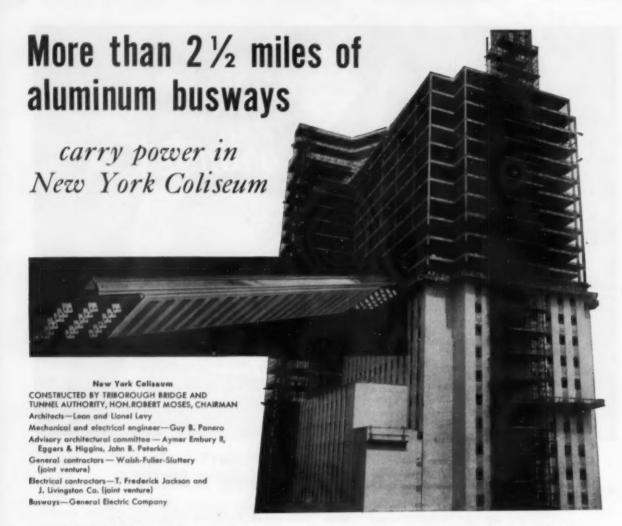
That's why nearly 2 out of 3 HPF ballasts* carry the famous CBM emblem. With CERTIFIED CBM BALLASTS

you're assured:

LONG BALLAST LIFE RATED LAMP LIFE
RATED LIGHT OUTPUT TROUBLE-FREE OPERATION
FREEDOM FROM NOISE

*Total ballast sales from U. S. Dept. of Commerce. CERTIFIED CBM BALLAST sales from ETL reports.





Important Innovations in Coliseum

New York City's new Coliseum is modern in every detail, particularly in its electrical distribution system. This 26-story office building, combined with 365,000 square feet of display space, has one of the first major installations of a higher voltage distribution system (480Y/277 volts). More than 2½ miles of busway incorporating aluminum conductors were used to feed power to this huge structure.

Higher Voltage System Saves Money

The higher voltage system provides greater capacity and flexibility than conventional systems. Yet it requires only half as many, or half as large, risers and feeders. Characteristics such as excessive voltage drop or costly power losses present no problems to this system. The use of lightweight aluminum bus bars makes the equipment easier to handle and easier to install.

More and more manufacturers of packaged electrical distribution systems are finding that Alcoa® Aluminum Bus Conductor offers advantages of lower cost, availability, design flexibility. Aluminum distribution bus weighs a third less than a copper system of equal conductivity. Pound for pound, it has greater current-carrying capacity than cable in conduit.

Alcoa Aluminum Is Your Best Bet, Too

Wherever your production requirements demand an efficient, flexible electrical distribution system, it will pay you to specify busways with Alcoa Aluminum Conductors. Write us for the names of manufacturers who specialize in this lighter, better, more economical product. Aluminum Company of America, 2302-K Alcoa Building, Pittsburgh 19, Pa.

Your Guide to the Best in Aluminum Value









Workman is henging shielding ground wires. 22,000 ft. of three neoprene-jacketed, single conductor cables were hung in a total of 12 working days. Circuit was designed to carry 3,500 kw of power to the mine operation

with an automatic regulation of 3% at 90% PF lagging. This type installation offered the advantages of single metering and a broadened load base.

At Idarado Mining Co., Telluride, Colorado

NEOPRENE jacketing protects 13 miles of underground 250 MCM 13,000 V cable



Preparation of load cable joint. Joints were made by connecting the conductor with a sleeve-type compression connector installed with a hydraulic compression tool. Outer jacket of joint was made with neoprene tape (shown in red).

To transmit power at 12,470 phase to phase volts, the Telluride Mines portion of the Idarado Mining Co, used 13 miles of neoprene-jacketed cable underground. Their choice of neoprene jacketing was the best possible assurance of dependable cable service.

Neoprene has exceptional durability. It resists soil acids and abrasion underground; sunlight and weathering above ground; oil, grease, chemicals and ozone anywhere. Longlasting protection for cables is assured. And because neoprene is flexible, cable installation is easier.

Next time you order, ask for cable that keeps maintenance and replacement costs to a minimum-cable jacketed with neoprene. It's available in single- and multiple-conductor types to meet your requirements.

NEOPRENE

The rubber made by Du Pont since 1932



BETTER THINGS FOR BETTER LIVING ... THROUGH CHEMISTRY

FREE! THE NEOPRENE NOTEBOOK. Every issue contains interesting stories about products made with neoprone. Actual case histories give you the facts about neoprone's longer service life-Clip coupon to get on the mailing list.

E. I. du Pont de Nemours & Co. (Inc.), Elastomers Division EC-10

Wilmington 98, Delaware

Name.

Firm.

Address. City. State_

Position

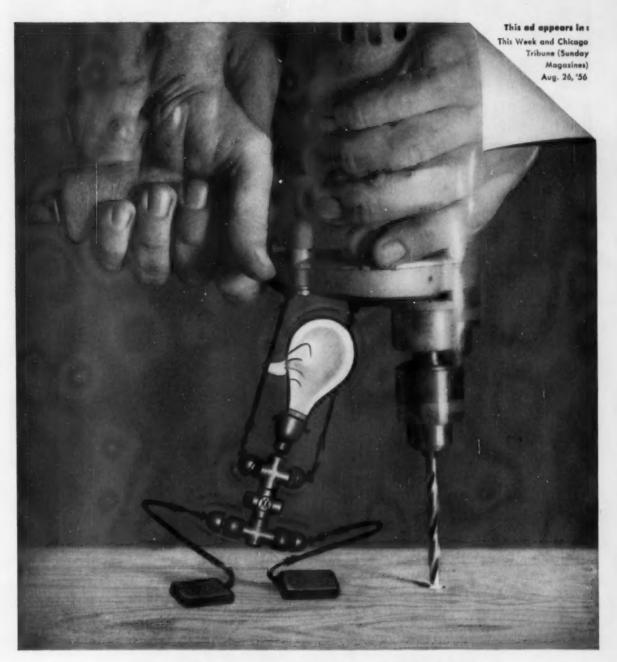
You profit when people read "Skimpy Wiring" ads like this...

Kennecott's national campaign for better home wiring with copper helps you get more profitable wiring contracts, more rewiring jobs.

Use this FREE material for your own better wiring promotions.

Send today for free reprints and poster-sized blowups of Kennecott's latest full-page national advertisements featuring "Skimpy Wiring." Get free copies of the educational booklet, "The ABC of Home Wiring." Ask for complimentary Home Wiring Wall Chart, mat service folder and list of at-cost prices of all material available. No cost, no obligation! Just write to Kennecott Copper Corporation, Dpt.EC106, 161 East 42nd St., New York 17, N.Y.

The Best Wiring is Copper!



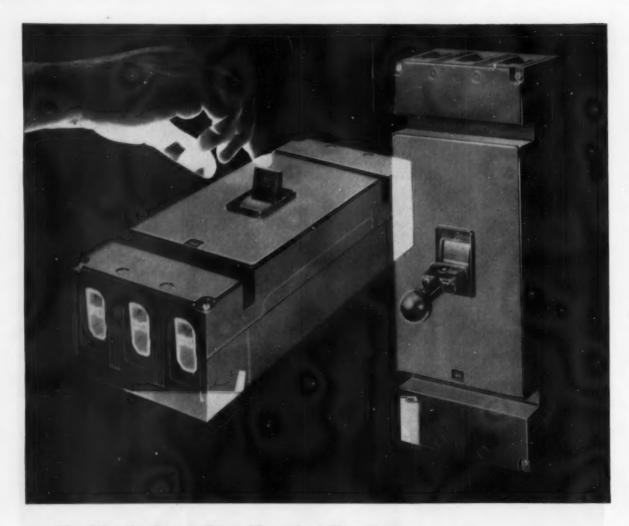
He makes slow work of do-it-yourself jobs!

Weak, undersized "Skimpy Wiring" actually holds back the electrical energy that gives muscle to motors. Don't expect new electric-drill bits or sharp circular-saw blades to speed your work if he is around. This current-steal-ing household pest can slow down and stall the finest power tools.

Find out how to rid your home of the many ring out now to rid your home of the many electrical ills symbolized by "Skimpy Wiring" Learn how easy it can be . . . how little it can cost . . . to give your home the full HOUSEPOWER of an up-to-date copper wiring system. Talk it over with your local power company or electrical contractor. Get FREE Booklet! "The ABC of Home Wiring." It clearly explains important facts about your electricity and how you can make it serve you better. For your free copy, just write: Kennecott Copper Corporation, Department L96, Box 238, New York 46, New York.



Kennecott Copper Corporation Fabricating Subsidiaries: Chase Brass & Copper Co. • Kennecott Wire and Cable Co.



The Westinghouse Type M - only fully rated 800-ampere, molded-case circuit breaker...

Saves 3/4 cost of larger devices

Over a year of customer use, as an alternative to larger 800-ampere protective devices, has proved the economical advantage of the Westinghouse Type M AB De-ion* circuit breaker.

Whether you use it singly enclosed or in a switchboard, you'll find it can save ¾ the cost of a larger air circuit breaker. Space or mounting economies may run the savings even higher—such as the use of this design in building compact distribution panelboards.

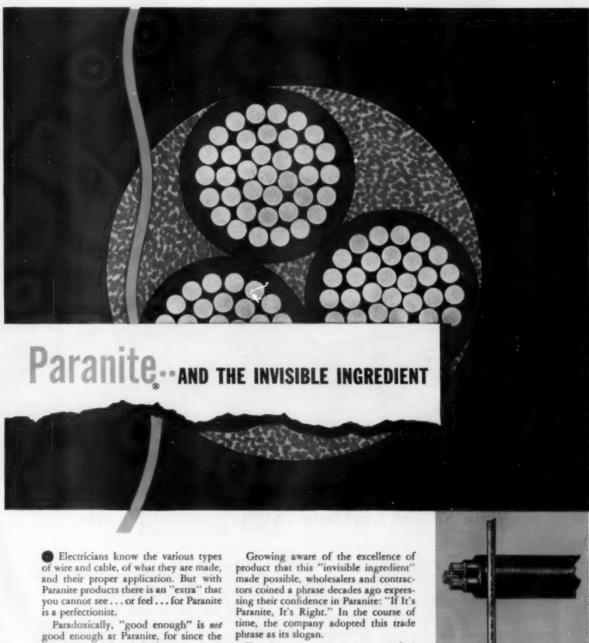
Though the smallest device of its rating, the new model will carry its full current rating in normal ambients even when enclosed—something other thermal devices cannot do. This feature of ambient compensation is useful in applications where standard units might unduly penalize system capacities. Both the Westinghouse true 800-ampere alternate and the standard thermal magnetic trip types are U.L. listed.

You owe it to yourself to get all the facts on the Westinghouse Type M circuit breaker. Get 'em today from your local Westinghouse sales office—or write direct to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

J-3021

WATCH WESTINGHOUSE!

WHERE BIG THINGS ARE HAPPENING FOR YOU



Paradoxically, "good enough" is not good enough at Paranite, for since the company was founded 66 years ago, it has been motivated by the desire to make a better product each day than the day before, if humanly possible. This became a habit, then a tradition, and today is the invisible ingredient.

True in past years—more true today! The "invisible ingredient" still silently assures you that every foot of Paranite Wire and Cable is as nearly perfect as human hands can make it . . . utilizing modern equipment and cautious testing.

PARANITE WIRE AND CABLE

FORT WAYNE 6, INDIANA

MANUFACTURING PLANTS: Birmingham, Ala.; Anaheim, Calif.; Jonesboro, Ind.; Marion, Ind.

Warehouses* and Sales Offices

*Atlanta, Georgia; Bosten, Massechusetts; *Chicago, Illinois; Cleveland, Ohia; Dallas, Texas; *Detroit, Michigan; Hartford, Connecticut; Indiana-

polis, Indiana; "Konsas City, Missouri; "Las Angeles, California; "Newark, NewJersey; Omaha, Nebraska; "Portland, Oregon; Upper Darby (Phila-

delphia), Pennsylvania; Rochester New York; "Saint Louis, Missouri, "San Francisco, California; Seattle, Washington; Springfield, Illinois.





This School Lighting is Easy on the Pupils

Yes, this school lighting installation is easy on the pupils and easy on the pocketbook, also. It features a standard Litecontrol fixture, our No. 6628, pendant mounted. The fixture is very simple to install because of its two-piece construction. Its curved sides eliminate dust pockets and can be cleaned in a jiffy.

This modern, well-lighted classroom with light finishes and almost no shadows shows how harmful contrasts can be eliminated. Note that intensity is somewhat higher than conventional classroom installations. Tests have proved that children in a classroom will cut down intensities as much as 25% as compared with an empty room. Thus, the youngsters here benefit by an extra quantity of high quality illumination.

Whether your next lighting job is a school, bank, library, shop or office . . . LITECONTROL fixtures will give you the right kind of light, in the right amount, in the right places - at the right price. See your local Litecontrol Representative.

INSTALLATION: Landonderry School, Middletown, Penna.

ARCHITECT: William Lynch Murray & Associates Harrisburg, Pennsylvania

ELECTRICAL CONTRACTOR C. R. Kilgore & Son, Camp Hill,

DISTRIBUTOR: Dauphin Electrical Supplies Company

MOUNTING HEIGHT OF FIXTURES, Approximately 9'-0"

FIXTURES: No. 6628 2 lamp pendant flatures, hung on 12" stems

INTENSITY: Average throughout room, 55 footcandles in service



LITECONTROL ixtures

LITECONTROL CORPORATION

DESIGNERS, ENGINEERS AND MANUFACTURERS OF FLUORESCENT LIGHTING EQUIPMENT DISTRIBUTED ONLY THROUGH ACCREDITED WHOLESALERS



Announcing

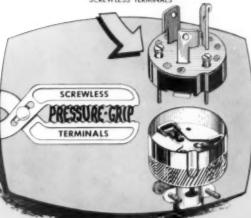
A revolutionary new Hubbell advance in wiring device design which provides the utmost in wiring security, safety and convenience.

New, Super Twist-Lock

SERIES 3000

Featuring PRESSURE-GRIP

SCREWLESS TERMINALS









REVOLUTIONARY... NEW... SUPER

SERIES 3000

Twist-Lock

FEATURING Screwless PRESSURE-GRIP Terminals with Dead Front



Wire ends simply press into their individual pockets and, with dead front in position, are securely locked in place.

Wire strands can't contact one another or spread out and touch steel shell. There are no binding screws . . . no wire looping





Cut-away of assembled 2piece cap showing power ful pressure grip action of contacts

SUPER TWIST-LOCK

answers the growing need on the part of electrical contractors, plant electricians and maintenance engineers for a locking connector that can be installed quickly with a minimum amount of work and effort yet with the positive assurance that the wiring will be absolutely safe and secure. Super Twist-Lock is vastly superior to competitive locking connectors both mechanically and electrically. The screwless terminals save valuable wiring time by eliminating troublesome wire bending and looping. Unlike the usual "wrap

around" binding post method, Super Twist-Lock assures wiring uniformity and maximum terminal contact. The two-piece construction of the cap contains all the wires. The blade front is "dead" i.e. no wires extend to the front of the cap, thus there is no need for a fibre disc. This contributes to utmost wiring safety and security.

Super Twist-Lock is the most rugged unit of its type ever produced. It is slightly smaller in size and lighter in weight than existing units and consequently more compact. Rigid tests prove that it will withstand the roughest industrial service con-

INTERCHANGEABLE

Super Twist-Lock is interchangeable with other locking connectors of equal size and rating. Either the cap or the connector body can be used in conjunction with existing units. This is advantageous in plants where regular Hubbell Twist-Lock or other competitive lock type connectors are presently installed on machine tools or other equipment.

Now Available In All Three Sizes

250 Volts

2-WIRE

2.Wire Cap

Cat. No.

3221

250 Volts

Cat. No. 3321

3-Wire

Connector Body

Cat. No.

3323

4-WIRE

4-Wire Cap

Cat. No.

3421

250 Volts

600 Valte (AC only)

3-Wire Cap

3-WIRE

4.Wire Connector Body Cat. No. 3423

600 Volts

(AC only)

2-Wire Connector Body Cat. No. 3223



Cuts Wiring Time 1/3



1. Use knurled section on shell as a convenient strip gage. (Insertions of individual conductors can be simplified by leaving insulation on wires, thereby containing strands.)



2. Spread cord clamps and insert conductors into holes making sure green (ground) conductor enters the hole marked with the designation GR.



3. With the cord pressed in firmly, tighten the cord clamps so that the position of the individualconductors will be maintained throughout the wiring operation.



4. Before snipping wire, gage correct length by bending the conductor into its position in the pocket. Wire should reach back wall of pocket. Snip with pliers.



5. Bend each conductor outward into its individual pocket. Then press each firmly into position.



6. Insert "Bakelite Blade Front" into keyed shell and engage the two sections securely by tightening each screw alternately until all are firmly seated.

ts Rugged withstands tumbling barrel torture test!



In order to test the ruggedness of this new unit, Hubbell engineers set up this tumbling barrel torture test. After ten minutes of tumbling barrel torture, Super Twist-Lock operated perfectly both mechanically and electrically. This is both the result of the small, light weight and compact design of the unit and the top quality materials and workmanship which go into its manufacture.

Captive Holding Screws

keyed to prevent interchange with cap



2-piece Cop





Greater Blade Rigidity

Heavy duty bakelite



Harvey Hubbell, INC.

Factory and Warehouse Locations Assure Nationwide Stock Availability

State and Bostwick Sts. 27 South Sangamon St. 103 North Santa Fe Ave.
Bridgeport 2, Conn. Chicago 7, III. Los Angeles 13, Calif.

1111 Drayon St. Dallas 7, Texas



At Your Nearest Electrical Distributor's Showroom



screw the dead front in position and it's finished. Six easy steps cut your wiring time up to 1/3 rd on any job. That's money in your pocket any way you look at it.

Yes, it's interchangeable with regular Twist-Lock. Use them along with any existing installation. No trouble at all.

Sure, they're available. We have them in stock right now!

9ti Super



Sold only through Authorized Distributors

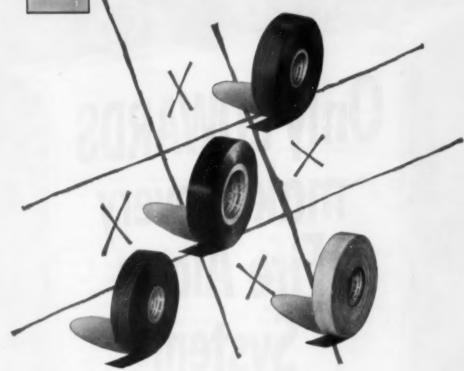
Harvey Hubbell, INC.

Main Office and Factory

BRIDGEPORT, CONN.

Factory and Warehouse Locations Assure Nationwide Stock Availability

big ways to beat high insulating costs



Tool up with

DUTCH BRAND'S BIG FOUR ELECTRICAL TAPES

Send for this new Big Four booklet now!

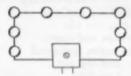
Here are facts that you can turn into dollars and cents! Dutch Brand's big, new "Big Four" booklet is packed with new ideas and methods for beating high electrical insulating costs. It tells how you can use Dutch Brand plastic tape, friction tape, rubber tape and vinyl color tape to improve electrical work . . . make jobs easier, faster and safer. You'll see exactly what these tapes will do . . . and find out how to choose the right tape to meet specifications of the job. Get a copy of this easy-to-read, well illustrated booklet for every department concerned with electrical insulation,

Johns-Manville

offer the right protection for every installation...

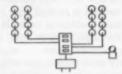
Only EDWARDS makes every Fire Alarm System*

HOME FIRE ALARM



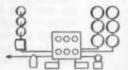
For small homes: the finest low-cost protective feature possible. Edwards Home Fire Alarm is an inexpensive, complete system. U.L. listed detectors. Installation needs only low voltage wiring between detectors and signal unit, gives instant warning of fire.

ZONALARM



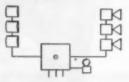
New! Fully automatic Zonalarm system protects large homes and farms 24 hours a day, regardless of power failures...sounds alarm and indicates location of the fire at a central point. Economical protection that's unique in its price range.

TYPE AMVAD



Completely automatic system combined with manual stations, gives 24-hour protection. Operates regardless of power failures. Sounds evacuation signal, indicates location of fire at a central station, may be used to signal municipal fire headquarters automatically. Fully supervised for complete safety.

TYPE CCVA



Simplest supervised system sounds an evacuation alarm without indicating location. Closed circuit, full supervision assures instant warning whenever system becomes inoperative due to open circuits, grounds or other defects.



HOMES

SCHOOLS

HOSPITALS

COMMERCIAL-INDUSTRIAL

*... and designs and manufactures every major component!

Only Edwards gives you fire warning systems that cover every building requirement, whatever the size, design or use! Because Edwards makes every type of fire alarm, your Edwards Technical Specialist can always recommend one that's exactly right for a particular installation.

Over 80 years of experience in designing and manufacturing signaling systems assure easy installation and absolute dependability in every Edwards system, whether manual or automatic, coded or non-coded, for homes, schools, institutions, or commercial buildings of any size or design. Complete

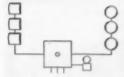
technical service backs you up on every job.

Capitalize on this profitable and rapidly expanding market by promoting modern fire alarm systems properly installed by you as a reputable Electrical Contractor. Recommend Edwards with complete confidence. Systems will meet local and state codes, Underwriters' listed where applicable. For complete information on any application, see your Edwards Distributor, Edwards Technical Specialist, or write Dept. EC-10, Edwards Company, Inc., Norwalk, Connecticut. (In Canada, Edwards of Canada, Ltd., Owen Sound, Ontario.)

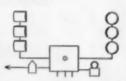
Specialists in Signaling Since 1872
DESIGN • DEVELOPMENT • MANUFACTURE



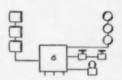
TYPE SSAMR



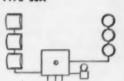
For smaller buildings: sounds a distinctive alarm signal. For buildings where automatic location is unnecessary. Full supervision with trouble bell guarantees continuous protection. TYPE SSAM



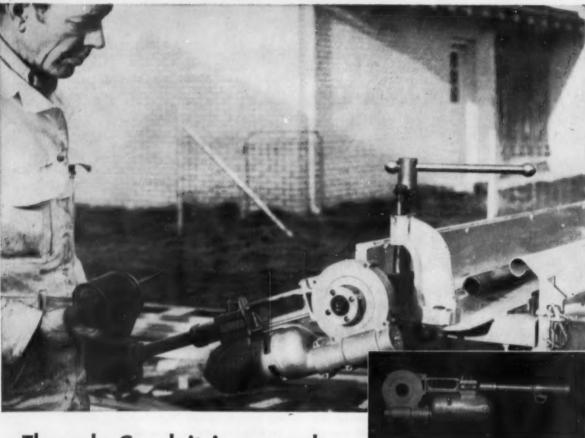
City-connected system sounds a coded signal within the building and also at the municipal fire headquarters, entirely automatically. Recommended particularly for large schools and institutions. TYPE PSSA



Pre-signaling system sounds a coded signal at certain stations only ... authorized personnel must initiate general alarm. Prevents needless evacuation, protects against the effects of false alarms. TYPE SSA



For large buildings: coded signal throughout the premises tells where alarm was sounded, locating the fire while it gives the evacuation signal. Fully-supervised system sounds a special trouble bell if there is any fault in the system.



Threads Conduit in seconds ...the Lawco, Jr.

PORTABLE PIPE THREADER

Here's the answer to those slow, tiring, hand-threading jobs. The Lawco, Jr. Portable Pipe Threader does the work in seconds. This modern portable power tool threads the smallest to the largest conduit. Simple adapters and speed reducers handle pipe from 1/4-inch to 10".

Its operation is simple. Just position Lawco, Jr. on the conduit, press the trigger, and the power unit drives the cutting dies. You're finished in no time, and right at the location where you are installing the conduit.

And Lawco, Jr. comes in handy for other jobs, too. Several are illustrated at the right. In addition to these applications, you can use your Lawco, Jr. for driving nuts and bolts, and hoisting weights up to 500 pounds.

This light weight (20 lbs.) tool is precision built for years of service. Write for details.

VELOCITY POWER TOOL CO.

201 North Braddock Avenue, Pittsburgh 8, Pa.

The Lawco, Jr.—portable, versatile, compact. Does a variety of jobs faster, better.



Augering operation with Lawco, Jr. Efficient in vertical or horizontal operations.



Post hole application using square shank. Lawco, Jr. does it faster.



There's nothing better for pulling wire through conduit that the Lawco, Jr. The unit's portable feature speeds work.



F. W. Hoelscher (left), K. B. Kruel of St. John's Poultry Farms, Inc. Hoelscher designed unique feeding system.







STREAMCOOLED MOTORS
help feed 120,000 chickens

Automatically!



 -Vertically-mounted, 2-HP Baldor Motor drives screw elevator which lifts corn grain from ground level into hopper for storage.



Hammer mill, powered by a 5-PP Baldor Motor, grinds grain and blows it to weighing bin and mixer.

St. John's Poultry Farms, Washington, Mo., boasts one of the most time and labor saving systems for feeding chickens in the world! Six block-and-a-half long broiler buildings house 20,000 chickens each. *One man* maintains each brooder.

Many Baldor Streamcooled Motors power these automatic feeding systems. Splash-proof, dust-proof, totally enclosed motors keep out powder-like grain that constantly fills the air. Non-clogging external fans can't cause trouble that might stop entire system.

This is just one case among thousands where Baldor Streamcooled Motors have been picked for a tough job—a job demanding outstanding ruggedness and dependability. Whatever the installation . . . whatever the application . . . you can recommend and install these field-proven motors with complete confidence—confidence inspired by over a third of a century of service in the electric motor industry.

BALDOR ELECTRIC CO.

4353 Duncan Avenue

St. Louis 10, Missouri



Special feed is mixed with ground corn. Vertically mounted, 3-HP Baldor Motor drives mixer. All motors are single phase.



ICRO precision switches

THEIR USE IS A PRINCIPLE OF GOOD DESIGN

industrial enclosed switches

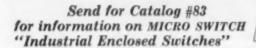
MICRO SWITCH

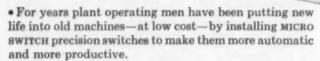


tatalog 83

CUT COSTS!

Make your plant more automatic and more productive





They do so by using MICRO SWITCH switches as limits, interlocks and safeties on almost every conceivable type of plant equipment. Special switches are available for use in explosive atmospheres or other hazardous locations. A wide variety of circuit arrangements, actuators and enclosures meets specific operating requirements.

Plant superintendents, electricians and maintenance men have found MICRO SWITCH products invaluable in making present equipment more productive. Full stocks of switches are readily available from authorized distributors who are as close as your telephone. Look under "Switches, Electric" in the Yellow Pages.

ANY OF THESE CATALOGS WILL BE SENT ON REQUEST.

62a · "Basic Switches"

82 • "Basic and Enclosed Switches"

736 · "Toggle Switches"

83a · "Industrial Enclosed Switches"

74b · "V3 Switches"

90e · "Mercury Switches"

75a · "Subminiature Switches"

101b · "Switches for Industry"

A DIVISION OF MINNEAPOLIS-NONEYWELL REGULATOR COMPANY

In Canada, Leaside, Taranta 17, Ontario . FREEPORT, ILLINOIS



HOW SWITCHES HAVE BEEN USED TO SAVE TIME AND MATERIALS

Stops needle breakage:

Switch stops knitting machine when slack develops in wire. Mechanism starts automatically when slack is relieved.

Protects personnel:

Explosion-proof switch installed on filter system permits operation of equipment only if vent valve is closed.

Prevents conveyor pile-up:

Two switches wired in series, each operating independently as sugar bag passes. When bags pile up, both switches are operated and conveyor stops.

Counts revolutions of mixer:

Switch connected with counting device is actuated by each complete revolution of mixing drum, recording number of revolutions at convenient point for operator.

Sell Up with PLUS FEATURES and NATIONAL LIGHTING STANDARDS



Now, there is a New, Easier Way to Sell More Jobs...Better Jobs...Bigger Profit Jobs!

Sell up to the standards...not down to a price! You do this and you sell up the quality, too, when you use the tested Certified Lighting method of selling! Show the prospect the PLUS FEATURES CHECK LIST! It's the easiest way to sell more lighting...extra lighting that means bigger profits to you...and much greater satisfaction for the customer! Show the prospect the Certified Certificate. It's the easiest way to uphold the job—to keep it from being cut. That's why this certificate is so important. You can and will deliver the kind of lighting they need. It all adds up to easier selling... Write for free booklet.

Is Certified Lighting In Operation in Your Area?

This program is operated locally under the joint sponsorship of all electrical groups. If your area is listed below, get in touch with your local group... otherwise, write The National Lighting Bureau.

Boston, Mass. Charlotte, N. C. Chattanooga, Tenn. Cincinnati, Ohio Detroit, Mich. Jackson, Miss. Los Angeles, Cal. New Orleans, La. Norwalk, Conn. Omaha, Neb. Providence, R. I. Rochester, N. Y. Sacramento, Cal. San Diego, Cal. San Francisco, Cal. Waterbury, Conn. Worcester, Mass.



Certified Lighting

NATIONAL LIGHTING BUREAU, 155 East 44th Street, New York City, Sponsored by the Industrial and Commercial Lighting Equipment Section of NEMA the National Electrical Manufacturers Association

This program is sponsored by all these member companies of the industrial and Commercial Lighting Equipment Section of the National Electrical Manufacturers Association to help you increase your sales...

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If it's worth Engineers' time...

... It's worth Engineered Cable

Belden

INTERCOMMUNICATING
AND
SOUND SYSTEM CABLES

Indoor-outdoor, phones or speakers—there is a Belden engineered cable to meet your needs for a permanent, troublefree installation.

"Items from the Complete Belden Line"

The TV station, the systems for music, paging, and intercommunication in the new Prudential Insurance Company of America's Building in Chicago have been—wired by Belden.

Belden

WIREMAKER FOR INDUSTRY SINCE 1902 CHICAGO

Magnet Wire • Lead and Fixture Wire • Power Supply Cords, Cord Sets and Portable Cord • Aircraft Wires

Welding Cable • Electrical Household Cords • Electronic Wires • Automotive Wire and Cable



PICK A LINE that's well-designed and well-engineered. Design and engineering are absolute essentials of good lighting.

PICK A LINE that's quality-manufactured . . . tops in finish, metal fabrication and in assembly. Owners and users will appreciate your insistence on quality.

PICK A LINE that's designed with the contractor in mind. You'll find installations cleaner, easier and much more profitable.

Smitheral

IF you keep these things in mind, we know from experience good lighting installations bring you more and more jobs . . . and we know that Smithcraft will get its share (or more) of your business.

The Sheraton (shown above) is an ideal unit for offices, schools, stores, and all kinds of installations . . . very shallow . . . very easy to install.

Ask us to send you the current Smithcraft catalog
... it is a compilation of the newest and most
functional fluorescent fixtures in use today.

America's finest fluorescent lighting



A Machine for Every Purpose ... PRICED FOR EVERY PURSE



For one-man portability, you can't beat this 80 lb. Oster No. 142 "Featherweight Champ." But don't let its light weight fool you . . . it's built to take plenty of rough, tough work anywhere there is threading to be done.



Here's the threading machine that just never wears out. Oster offers the rugged No. 432 "Lightweight Champ" with full confidence that it will save you money. It's easy to move... easy to use... literally the standard for all types of users.



For more continuous use, specify the new Oster No. 552 "Pipe Master." Here's a complete portable pipe and bolt threading machine with "Auto-Grip" front chuck . . . quickopening, adjustable, floating-type Die Head . . revolving, rear-centering chuck.



For the ultimate in pipe and bolt threading performance, it's the revolutionary Oster No. 582 "Tom Thumb" Portable Pipe Machine. Has built-in Thread Length Gauge, Cut-Off Device and Length Gauge . . . equipped with two quick-opening, fully adjustable die-heads.



Here's a real time-saver for every maintenance crew...a proved cost-cutter for your industrial plants. It's the rugged, handy Oster No. 420 "Sewer Master", the machine that makes short work of clogged drains and sewers. Easily and quickly removes obstructions 100 feet or more from sewer entrance.



THE



MANUFACTURING CO.

Main Office and Factory: 1313 East 289th Street Wickliffe (Cleveland), Ohio



make the Oster line the most complete line of its type in the entire world. From lightweight, portable threading machines to heavy-duty production pipe and bolt threading machines, Oster products are designed and built to give years of dependable, trouble-free performance with a minimum of care and maintenance. For contractors . . . for industrial maintenance departments . . . Oster offers the right machine for every threading job. Write for free catalog.

Here are but five of the versatile, dependable machines which

Columbia-UF

UNDERGROUND FEEDER AND BRANCH CIRCUIT CABLE

FOR DIRECT EARTH BURIAL*



APPROVED BY UNDERWRITERS' LABORATORIES

PROVIDED WITH OVERCURRENT PROTECTION

WRITE TODAY FOR ILLUSTRATED BOOKLET

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Serving the Electrical Wholesaler Since 1912

255 Chestnut St.

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Sales Representatives in the Following Cities: Atlanta, Ga.; Boston, Mass.; Charlotte, N. C.; Chicago, III.; Cleveland, Ohio; Cincinnati, Ohio; Dallas Texas; Detroit, Mich.; Glassport, Pa.; Houston, Texas; Kansas City, Me.; Los Angeles, Calif.; Miami, Fla.; Minneapolis, Minn.; New Orleans, La.; New York, N. Y.; Philadelphia, Pa.; Portland, Ore.; St. Louis, Mo.: Sen Francisco, Calif.; Seattle, Wash.; Tulsa, Okla.; Utica, N. Y.

Keeping production on the move with Westinghouse pushbuttons



On Ford assembly lines, automation starts with the press of a button. From the paint line (shown), 18 different body styles are automatically guided to various trim lines. As each body passes the operator, he channels it to the proper trim line simply by pressing a button.

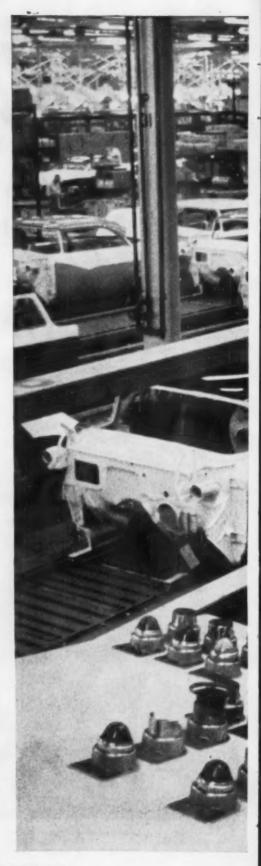
In textile mills, steel, paper or fabricating plants, Westinghouse pushbuttons are also on the job, guiding smooth-functioning lines of material to finished product stages. Doing it faster, better, and at a lower operating cost to you than ever before possible.

From Westinghouse you can get precisely the right operator, enclosure, whatever you need—when you need it. Complete lines of standard-duty, heavy-duty, and Oil-Tite* pushbuttons are stock items with Westinghouse.

Write to Westinghouse, Box 868, Pittsburgh 30, Pa., or see your nearby Westinghouse distributor for a copy of the new *Pushbutton Guide*, B-6749.

WATCH WESTINGHOUSE!

WHERE BIG THINGS ARE HAPPENING FOR YOU!





ELECTRICAL CONSTRUCTION AND MAINTENANCE . . . OCTOBER, 1956

Monument to Power"

Every engineered structure stands as a tribute to the men who planned and built it. And to the efficiency of their equipment, too. Simplex-ANHYDREX cables, for instance, which are used everywhere for power distribution, control, floodlighting and numerous other functions. These expertly-engineered cables are equally suitable for overhead or in-theground use. They resist sunlight, ground acids, alkalies, oil, heat and flame, and their ANHYDREX insulation makes them super-resistant to water.

SIMPLEX WIRE & CABLE CO..

79 Sidney Street, Cambridge 39, Mass.





Lighting Steps Out

A new step in lighting progress is in the making. Several specialized installations are now operating at the 200 footcandle level, and experimental installations in excess of 400 footcandles are proving to be practical and comfortable. The "glare barrier" which was threatening to limit practical artificial illumination to about 150 footcandles has been effectively penetrated by advanced engineering design and application.

Present industrial and commercial design practice, centering around 100 footcandles, is not necessarily rendered obsolete by the advanced installations which are appearing. Such practice provides, with well designed luminaires and skillful application, very good lighting within an economical and readily acceptable range of installation and operating costs.

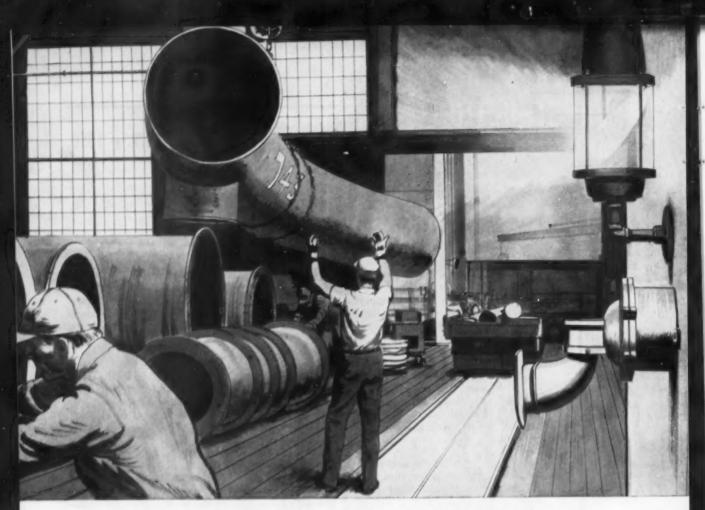
What the new systems do is to greatly expand the reach of practical lighting technology for those applications where higher illumination levels offer opportunities for distinct improvements in process, efficiency or visual environment. It is significant that with every forward step in lighting design, the practical opportunities for more advanced applications have multiplied rather than lessened.

The achievement of high levels of comfortable, shadowless illumination from uniform areas of low brightness, however, has tended to distract attention from the significant values and uses of supplementary sources. This trend is also changing. Directional, shadow-forming light, even in the presence of high intensity general illumination, is important to many critical seeing tasks. Modelling light gives depth, form and dimension though it may add relatively little to the average intensity.

Critical examination of current trends and objectives in lighting will disclose that substantial areas of progress are entirely practical with existing and readily available lamps, components and luminaires. However remarkable the novel developments coming out of the laboratories and design studios, the spectaculars of current lighting progress are mostly bold, ingenious applications of commercial products to space and function.

If the role of lighting in the electrical industry required only an alert competence with current progress in lighting methods and products, it would be very important indeed. But, in recent times, lighting has become decisive in the whole area of electrical systems design. It dictates the size of wire, the layout of conduit, the quality and location of panelboards, the selection of voltage and frequency. It is a field in which creative imagination, rigorous engineering and skilled workmanship find a common cause. And, for the future, the sky is the limit.

Um. T. Stuart



Your customers may need audible and/or visual signaling facilities for paging or warning. They may need intercom for a dozen different industrial conditions. You can meet every signaling need by calling Graybar.

How to plan SIGNALING that will

LOCATE - WARN - PHONE

anyone, anywhere in the plant-or out

New construction, additions or modernization may confront you with signaling problems. By calling Graybar first, you'll get the facts on the newest and finest developments of such leaders as USI on sound powered telephone; Edwards code-paging and calling systems; Webster intercom, Federal signals and Sperti Faraday annunciators and clocks for every usual and specialized condition.

Calling Graybar enables you to fill every signal need from one single, convenient source. Your Graybar Signaling Specialists make it their business to know the special advantages of all the latest equipment.

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Everyone who plans, uses or installs signaling equipment can use a copy of this free Signaling Selection Guide, produced by the Federal Sign and Signal Corporation. If you are located in the U.S. or possessions, write for your copy.

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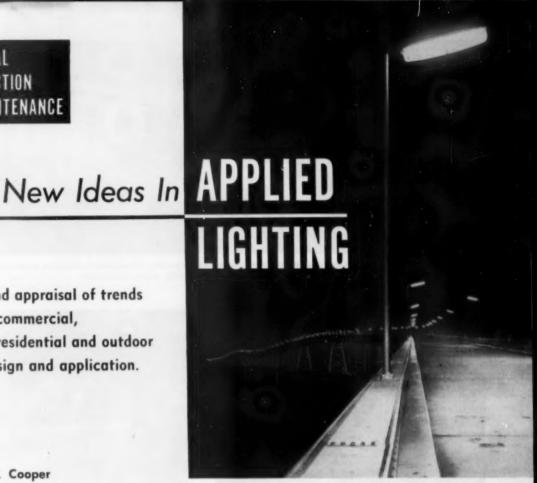


GRAYBAR ELECTRIC COMPANY, INC., 420 LEXINGTON AVENUE, NEW YORK 17, NEW YORK, IN OVER 130 PRINCIPAL CITIES

ELECTRICAL CONSTRUCTION AND MAINTENANCE

Roundup and appraisal of trends in modern commercial. industrial, residential and outdoor lighting design and application.

By Berlon C. Cooper



FLUORESCENT LAMPS in plastic-enclosed bracket-arm luminaires provide light for driving over the new Richmond-San Rafael bridge across San Francisco Bay.

IGHTING progress is on the march. It is beginning to hit a new and healthier stride. New ideas in lighting design are making their appearance, and a new appreciation for better coordination of lighting and architecture, and of lighting and decoration, is being evidenced in lighting application.

Analysis of lighting installations across the nation shows a strong trend to higher levels of illumination. with improved brightness ratios. In the main, these are being achieved principally with large-area, lowbrightness luminaires, and with luminous or louvered ceilings. New and better light sources are inspiring many new types of luminaires. And at the lighting system design stage, lighting effects and lighting results are beginning to take precedence over nonessential luminaire details which do not contribute to better illumination for more comfortable seeing.

Presented here in 18 pages are typical installations showing some of the more important trends in lighting, for a wide range of applications. These installations were selected by lighting equipment manufacturers as representative of today's best lighting practice. They provide a wealth of new lighting ideas which can be used in planning lighting jobs.

HE field of outdoor lighting has been expanding slowly in recent years, but the end-use market has changed more rapidly. Sports lighting hit a peak in early post-War II years, has since declined as most of the major sports facilities have been lighted. But other markets, especially the lighting of roadway approaches and parking areas for suburban shopping cen-

ters and super markets, parking lots, and the lighting of viaducts, bridges, tunnels, streets and highways, have been increasing.

Outdoor lighting equipment designs are beginning to change. While floodlight units for incandescent lamps continue to be used for most typical floodlight installations, such as buildings, monuments, and major and minor sports areas, new designs are available and being used for street and highway lighting, tunnel lighting, for parking areas and filling stations, airport terminal aprons, etc. These new designs are generally for mercury and fluorescent lamps, with their longer life and more efficient light output.

Buildings, monuments, etc. are most efficiently floodlighted when

OUTDOOR LIGHTING (continued)



FLOODLIGHTING of buildings provides identification and advertising value. Incandescent lamps in weatherproof floodlights, set back from building, light this Greenville, S. C. office building uniformly and dramatically.



NIGHT LIGHTING of sports fields affords after-dark entertainment for both players and spectators, as typified by this Little League baseball field.



OUTDOOR LIGHTING is used at the Miracle Mile Shopping Center, Monroeville, Pa., to attract customers and to make it easy for them to identify the stores and to see to park.

the floodlight units can be mounted some distance away from the surface being lighted, so that the floodlight beam is as nearly normal to the surface as possible. In many cities, however, the building facade and the building line coincide. A recent trend in such cases is to install concentrated R-lamps in a cornice housing along the upper edge of the building, or along the second or third floor line, with lamps on 6 to 8 inch centers, and to "wash" the front of the building with light. In cases where buildings have setbacks, floodlights can be concealed on the roof of the building adjacent to the surface, or on the outer edge of the sidewalk marquees. In cases where only one- or two-story walls are to be lighted, cornices which house one or two continuous rows of fluorescent lamps, with concentrated type specular reflectors, have been used successfully.

For the lighting of small private parking areas, where low intensity lighting is adequate, PAR-type flood and spot lamps installed in weatherproof swivel housings mounted from 12 to 18 feet above the ground have proved satisfactory.

Mercury lamps continue to be used to light gasoline service stations, usually in open type reflectors which are pole mounted at the building line. Their distinctive color quality attracts the attention of the motorist to the stations, and helps to build business.

Shopping centers and outlying supermarkets are taking advantage

of the attraction value of outdoor lighting more and more to draw customers. Both mercury and fluorescent street lighting luminaires are being used to light entrance roadways, usually to double or more the intensity of the main streets or highways. Similar units are also being pole mounted throughout the parking areas to provide adequate light for entrance and exit, and for safety. Floodlights are often used on high towers to floodlight the parking area, and a recent development is a large metal dome which is pole-mounted that houses four 400-watt Type E-H1 mercury lamps and provides a square light-distribution pattern over the ground below by means of oval aluminum reflectors and prismatic glass refractors. These units



ATTENTION of shoppers is directed to this Syracuse, N. Y. store by flooding the entire front of building with light. Incandescent lamps were used in two different types of floodlights, installed at outer edge of street canopy.



LIGHTED POOL makes swimming at night an enticing sport. Underwater floodlights using incondescent lamps are recessed in wall of this pool at Broadmoor Hotel, Colorado Springs, Colo. Use of color lenses on floodlights adds decorative touch.



PARKING at the Park 'N Shop Shopping Center in Leyden, III., is facilitated by fluorescent lighting from weatherproof 4-lamp fluorescent street lighting luminaires.



GOOD LIGHTING over entire parking area at Hutzler Bros. suburban store in Towson, Md., makes shopping easy and safe at night, also helps to attract customers.

are also ideal for swimming pools, playgrounds, beaches, amusement centers, and similar areas where light is needed over a large area.

Fluorescent lamps in specially designed continuous row equipment continue to be popular for the lighting of tunnels and viaducts. They are also being used in special asymmetric light distribution units for lighting bridges, as well as streets and highways. No doubt these applications will increase considerably over the next thirteen years, under the impetus of the Federal Aid Highway Program. Both upper and lower decks of the recently completed Richmond-San Rafael bridge across San Francisco Bay are lighted to intensities of 1.0 to 1.5 footcandles.



MERCURY LAMPS in pole-mounted floodlights light this gasoline service station brightly to attract attention to it, also provide plenty of light over driveways for servicing customers.

LIGHT FOR THE HOME

FLOODLIGHTS provide dramatic and utilitarian outdoor lighting for this home, and decorative touch, and contribute to better living—electrically.





LIVING-DINING area is made cheerful through lighting treatments carefully integrated into structure and with room furnishings. Lighting includes table lamps, lighted window curtain, louvered ceiling panel in front of window, hanging reflectors, recessed wall niche, and indirect lighting from large urn in corner.



KITCHEN is uniformly lighted throughout by luminous ceiling, and work counters are highlighted by a continuous line of fluorescent lamps under cabinets. Glass bottom shelf in corner cabinet allows light from lamp under cabinet to add sparkle to glassware.

HE wide range of problems faced in providing adequate and comfortable light for the home is greater than in any other field. These problems vary from using lighting effects-light, color, shadows-as a decorative medium (in lieu of stylized "fixtures"), to providing light of proper intensity and comfortable quality for seeing purposes. Light can and should be used for decorative purposes throughout the home, on the lawn and in the garden outside the house, in the living and dining rooms, in halls, foyer, den, and in the bedrooms, and in the play room or recreation room. Utilitarian light is needed for greater seeing comfort for reading, writing, sewing, studying, shaving and cosmetic makeup, food preparation and serving, laundering, ironing, playroom activities, hobbies and workshop, etc.

Lighting know-how, and the necessary lighting equipments to provide ideal light for living in the modern homes of today, are available. The know-how embraces the proper selection, placement and method of installation of the specific light sources and lighting equipments to produce almost any conceivable lighting result, from the myriad number of light sources and light control devices and accessories which are now available. The lighting equipments and accessories range from literally hundreds of sizes, shapes, and colors of incandescent, fluorescent and mercury light sources to portable floor and table lamps, permanent type "fixtures" or luminaires, valances, cornices, coves, coffers, luminous ceilings and luminous area luminaires, and a wide range of recessed and built-in types of units. And beyond the limits of lighting flexibility afforded by the wide choice of sizes of light sources, multiple switching of circuits, and types of light distribution already available, are new and practical dimmer control devices for unlimited flexibility of the lighting results.



CORNER of a living room is given cheerful atmosphere by floor lamp and valance lighting over window drapes. Valance becomes a cornice over the doorway.



STAIRCASE is lighted dramatically and practically by fluorescent lamps concealed under banister and under each riser of the steps, to provide maximum safety.



RECREATION area is lighted by recessed troffer units using diffusing lenses, recessed incandescents over bars, fluorescent cornice in lounge area.



BATHROOM in this Miami, Fla. home is lighted by a recessed fluorescent unit with glass diffusing panel installed in ceiling over mirrors.



TELEPHONE corner is effectively lighted by 2-lamp fluorescent strip above diffuser installed on ceiling adjacent to wall. This technique is also ideal for wall desk.



BEDROOM is artistically and comfortably lighted by a fluorescent cornice over head of bed, two bracket lamps, and a center ceiling luminaire.

But what of the trends in home lighting in practice? Is this knowledge of how to light the modern home being put to use? The answer is emphatically NO! Of the more than one million new homes built annually, less than 0.5% of the cost of the home goes into lighting, exclusive of portable lamps. This is about one-fifth of what it should be, on the average, if homeowners are to enjoy even minimum benefits of what good modern lighting has to offer today.

Most of the low cost homes valued at \$12,000 and under are being lighted by about \$25.00 worth of "fixtures", retail price, on the average. And even the houses valued at \$35,000 to \$50,000 are normally equipped with lighting "fixtures" valued at about \$150.00 or less, retail. Certainly the families that buy these homes will not, and cannot, enjoy the convenience, pleasure, and many benefits provided by properly designed and adequate light for living which is now available to them.

This situation is due for a change. And it now looks as if we may soon see some progress in this direction. It is estimated that more than \$1 million will be spent on home lighting promotion this year, by the equipment and light source

manufacturers, the electric utility companies, by lighting distributors and retailers, and others. Also, three national programs are devoted partially to home lightingthe Live Better Electrically, Housepower, and Operations Home Improvement programs. Some of the newer lighting techniques that are applicable are shown in the accompanying photographs. There are many others that are equally suitable. But all of these ideas and the benefits of better home lighting have to be sold to homeowners. architects, and builders, and this is a job for the entire lighting in-



CORRUGATED vinyl plastic forms wall-to-wall luminous ceiling in Manufacturers Trust Co's new Fifth Avenue building, New York City, a spectacular installation dramatically integrated with four-story all-glass facade on two sides.

UMINOUS CEILING LIGHTING



ALUMINUM LOUVER panels with 3/4-in. hexagon cells form contoured luminuous ceiling for this telephone center, built at San Francisco's Cow Palace for the 1956 Republican National Convention.



LOUVER DIFFUSER of plastic was used to form this novel "inside marquee" in this Saginaw, Mich., drug store. This fan-shaped design treatment was formed with standard parts.

F THE many new developments in lighting system design announced since the end of World War II, the luminous ceiling (louvers or diffusers) has received by far the greatest acclaim and popularity. Historically, louvers extending from wall-to-wall below flourescent lamps, dubbed "louverall", were the first to make their appearance. This was an outgrowth and extension of the principle of shielding the flourescent lamps in a typical luminaire with metal or plastic louvers. Louvers were made of every suitable type of material -wood, steel, aluminum, plastic, and even glass. Louver patterns ranged from parallel baffles to (eggcrate), rectangular, hexagonal, octagonal, circular, oval, and other shapes, with cells in a range of sizes from about 1-in. to 12-in., and deep enough to provide from 30 to 45 degree shielding.

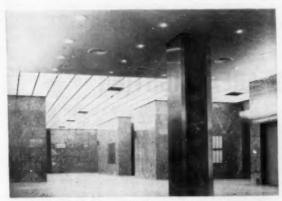
In early louverall ceiling jobs the plenum surfaces above the ceiling were painted black, to conceal pipes, ducts, beams, etc. from view through the louver cells, and lamps were equipped with reflectors. This arrangement created a pattern of highlights and shadows in the louver ceiling. Louvers were also finished in a range of finishes and reflectances, varying from specular to diffuse aluminum and from white to black paint or enamel. Tests soon revealed that cavities finished flat white, lamps installed bare on wiring channels, and louvers finished white or diffuse aluminum, provided greatest efficiency, and a uniformly lighted appear-



MOULDED squares of vinyl plastic form wall-to-wall luminous ceiling in San Diego department store, is used throughout block-long first floor, and most of four upper floors.



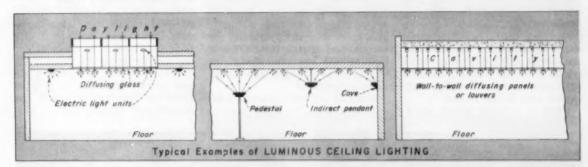
SOUND BAFFLES are applied beneath corrugated vinyl plastic diffusers in this Pittsburgh electric utility. Acoustical treatment helps to shield the diffusers from workers when viewed crosswise,



GLASS DIFFUSERS form the luminous ceiling in elevator lobby of New York's new Coliseum. Air conditioning outlets are same module dimensions as diffusers. T-bars form 24-in. square support for diffusers and air outlets.



METAL LOUVER panels form luminous ceiling in this display room. Cells are 3/4-in. cubes. Incandescent spots are concealed above metal pan near wall. All lamps are dimmer-controlled for variety of lighting effects.



SKYLIGHT LIGHTING, a forerunner of today's luminous ceiling, made use of both daylight and electric light.

INDIRECT LIGHTING, practiced for half a century, in essence makes a white opaque ceiling becomes "luminous".

LUMINOUS CEILING in modern day version transmits light from lamps in plenum cavity through diffusing or louver panels.

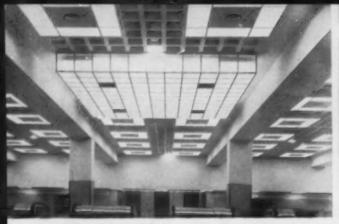
Diffusing panels were next used in place of louvers with the same type of lamp and wiring channel system. Originally glass, tracing cloth, etc. were used for experimentation and study. Then plastic was developed and tried, both in flat sheets and corrugated form, with various transmission properties. Out of this has come the present day luminous ceiling lighting system.

Along with the increasing use of

luminous ceilings have come some outside problems—disposition of air conditioning outlets, sprinkler heads and acoustical material, and provisions for partitions.

Fortunately, these problems have all been met and solved satisfactorily, and in the solving new ideas for still further progress have evolved. Standardization of dimensions for louver and diffuser panels is beginning to develop. Modular design has penetrated the lighting

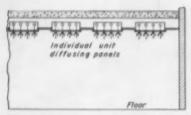
field and standard modules are now available. Some standardization of supporting rails, T-bars, etc. seems practical, and may lead eventually to interchangeability of the various panels, air outlets, acoustical tile, and other devices. New and unique methods for combining lighting and air diffusion have resulted, and now a growing number of new diffuser and louver panels are being introduced. The future for luminous ceilings looks bright!



LUMINOUS ELEMENT 22-ft long by 12-ft wide and 2-ft deep is surface-mounted over escalators at New York's Coliseum to identify location and flood area with light. The 8-ft square units are used throughout to provide general lighting in exhibition areas.



LARGE-AREA deep-recessed 8-ft square units with 6-in. cell aluminum louvers light waiting concourse of Union Passenger Terminal, New Orleans. Each luminaire contains eight 96T12 slimline lamps. Louver fins are 6-in. deep, formed of $\frac{3}{4}$ -in.thick aluminum, provide good appearance.



TYPICAL Luminous Area Lighting Detail

A RELATIVELY new and growing trend in lighting is the use of large luminous units of low brightness. Basically these units consist of a self-contained housing complete with lamps and wiring accessories, and a panel for diffusion of the light, or for shielding the lamps. Or, they may be a typical luminous ceiling treatment, but limited to a smaller than wall-to-wall area in the ceiling.

From a lighting layout stand-

LUMINOUS AREA LIGHTING

point, this type of lighting may be considered as a compromise between wall-to-wall luminous ceiling lighting, and some of the earlier recessed lighting techniques, in which such units as recessed troffers or surface-mounted diffuse type lighting units of approximately 12-in. width were used in pattern designs to provide maximum uniformity of light diffusion. From an architectural design viewpoint, however, as well as from an economy viewpoint, large luminous area units offer an opportunity for unusual and artistic integration of lighting and structural design, as well as for providing a high quality illumination result.

Many of the self-contained luminous area units, for either surface mounting or for recessing, are designed on a modular basis. Since the majority of these units are for use with fluorescent lamps, the lamp dimension module has been adopted. Unit sizes range from 24-in. by 24-in. to 48-in. by 96-in., in increments of 24 in. Larger luminous areas of any 24-in.-module dimension, up to a wall-to-wall treatment, can be assembled easily with these standard units.

There are also available circular and oval shape self-contained luminous area units, varying in size from 2 ft to 8 ft in diameter for the circular units, and from 30-in. by 48-in. to 72-in., by 96-in. for the oval units. These can be used to break the monotony of square and rectangular lighting layout pat-



LUMINOUS UNITS in ceiling of this Mobile, Ala., bank are 4-ft by 24-ft, consist of plastic louver panels below special fluorescent strips fitted between Q-flooring, provide 75 footcandles of uniform lighting throughout.



PLASTIC PANELS in semi-circular shape diffuse light from R-40 lamps above, to light fireplace and curving stone wall in lounge of a Fort Worth, Texas, county club. This luminous area highlights fireplace, accents stone wall texture.



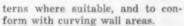
LOUVER PANELS of plastic form large luminous areas in high ceiling of this Ponca City, Okla. bank, provide ceiling pattern design, plus 65 footcandles of comfortable lighting.



ROUND PANEL of louver-plastic diffusers conceals old skylight, provides over 200 footcandles in area below in this St. Joseph, Mo. library. Fluorescent lamps in cavity were installed in RLM reflectors.



CEILING PANEL is 16-ft by 32-ft, formed of 2-ft square diffusers in self-contained housings for lamps and auxiliaries, provides natural daylighting effect in this Tucson, Arizona museum.



Self-contained luminous area units are in general fairly efficient. The lamps are installed in metal housings having efficient white reflecting surfaces, and interreflections provide high diffusion.

Four types of panels are available for these luminous area units. Diffusing panels are available in plastic or glass. Louvers are also available in metal or plastic. Some manufacturers provide all four types. Others specialize in one or more types of panels, having specific individual designs. This variety offers the lighting designer and architect new freedom and fexibility in working out custom layouts having individuality, and conforming more closely to architectural design detail.

Luminous area lighting, by virtue of its design, permits the use of up to 1000 footlamberts using outlets, ceiling acoustical treatment, fire protection with sprinkler heads, and installation of new partitions at preplanned locations.

Research on electroluminescent panels continues, and brightnesses of up to 1000 footlamberts, using high frequency power supply, have been reported. This achievement was with a laboratory set-up. But this development remains in the laboratory and research stage at this time. It is confidently expected by most researchers in this field that these panels will eventually be developed to the point of practical application. When this occurs, the panels will probably be used as luminous area units, and in wallto-wall applications, both on ceilings and on side-walls and columns.



SEMI-RECESSED 4-ft by 8-ft luminous panels of one-piece formed Plexiglas light bank in Los Gatos, Calif., to intensity of 50 footcandles, present simple, clean lines.



CIRCULAR AREAS 15-ft in diameter light new bank in Denver, Colo., and use circular louvers with cells $1\frac{1}{2}$ -in, in diameter and $1\frac{1}{2}$ -in, deep. Louvers are steel, finished baked white enamel.



Light for Easier Seeing

- Lighting levels rise as design techniques and new control devices break through the glare barrier.
- Directional light component in diffuse illumination installations proposed for easier seeing.



VISUAL COMFORT is at a new high in this custom-designed light, sound, and airconditioned conference room. Carefully shielded recessed down-lights provide highlevel perimeter lighting on conference table, while cove lighting adds diffuse illumination and recessed lenses light walls softly. All lamps are dimmer controlled.

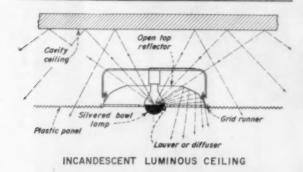
TROFFERALL ceiling which provides an initial intensity of 450 footcandles with visual comfort is a new addition at General Electric's Lighting Institute. Low-brightness type aluminum 2-lamp troffers, cross-louvered, are installed edge to edge over entire ceiling except for perimeter trim. The 96 40-watt rapid start lamps are dimmer controlled. Now under test and study, its full characteristics will soon be reported in detail.

THE great obstacle to lighting comfort, the glare barrier, has finally been penetrated. Through a new lighting design technique, and a new light control device (see photos and captions), high levels of illumination of 300 footcandles and above are now practical without glare discomfort. And lighting research now in progress will probably carry this trend much further.

Many practical installations of 125 to 200 footcandles have been made in recent months, in which fairly satisfactory visual comfort was achieved. Now, with these new design and light-control developments, plus the recent development of new fluorescent lamps which have double the light output of previous fluorescent lamps of equal size, the lighting industry has open to it and may well achieve a new goal of comfortable high intensity lighting for easier seeing.

New Lighting Technique

Luminous ceiling lighting has achieved considerable popularity over the past several months, which seems destined to continue. Several years ago, indirect lighting experienced a similar popularity. But indirect lighting had one inherent fault, among others, that limited its application and use. When intensities in excess of about 50 fc were attempted, ceiling brightness increased to the point of becoming an annoying source of glare.





FILAMENT LAMPS of the silvered bowl type, installed in 2-ft sq open top reflectors, are used with wall-to-wall plastic diffusers to light this office. Lamp and reflector are shielded by metal or plastic louvers, or glass or plastic diffusers. Spill light through reflector top opening (see detail, above) lights plenum cavity and indirectly lights corrugated plastic panels which form ceiling.

Luminous ceiling lighting has many worthwhile attributes, and its current popularity is well deserved. It has certainly helped to raise the standards of lighting, not only within the lighting industry but also with architects, consulting engineers and customers. But it. too, like indirect lighting, has two inherent characteristics which many lighting engineers consider as undesirable. First, its brightness is considered excessive for maximum comfort in seeing, especially when large areas of ceiling are visible without shielding.

Second, its complete diffusion of the light, extolled as a virtue by its makers and sellers, is considered by others as undesirable where visual tasks involve the need for sharp visual acuity. In many areas where seeing tasks require sharp vision, part of the lighting at the task should be directional, to provide some shadow effect or what is often called a modeling effect. This directional light might well be superimposed on the work areas in the field of totally diffused illumination, to provide even better light for easier seeing.

Three of the accompanying photos illustrate this principle. In effect, the lighting in these jobs simulate the effect of direct sunlight on a clear day, in which the sky provides diffuse and shadowless illumination, and the sun provides directional light. These are the conditions under which seeing is considered easiest, when contrast between highlights and shadows is at a maximum. lighting result from a luminous ceiling may aptly be described as similar to that produced outdoors on an overcast day.



SEEING is made exceptionally easy at this desk by providing directional light from the suspended luminaire which supplements the diffused indirect illumination, gives enough shadow detail to sharpen visual acuity. All light sources are dimmer controlled for wide variation in lighting effects.

PRISMATIC PLASTIC in a new 2-ft square ceiling lens plate made possible this 300 footcandle office lighting installation with lens brightness below 200 footlamberts in all usual viewing angles. Lenses are installed side by side to form two 6-ft by 12-ft luminous areas, but may be combined for any 2-ft module arrangement. Lens plate is slightly concave downward with translucent struts, smooth on upper surface.



MODULAR LIGHTING

DEVELOPING trend that can-Anot be ignored by the pro-industry, especially by those producing and selling recessed and built-in units, or luminous ceilings and luminous elements using fluorescent lamps, is the growing use of modular systems of standardized dimensions. Architects and builders are currently giving this subject much thought and study, in an effort to standardize production on a wide range of building materials, furniture, and mechanical equipment and thereby help to reduce constantly rising building costs.

Fluorescent lamps are made on a module dimension now, having been set up on that basis originally when they were first brought out. However, this dimension is on an exact footage basis, including lampholders, from two feet to eight feet, or multiples thereof; and when building modules are set up on similar dimensions, such as four feet or five feet, to include wall partitions, this presents a problem to many of the lighting manufacturers, depending upon the details of their designs.

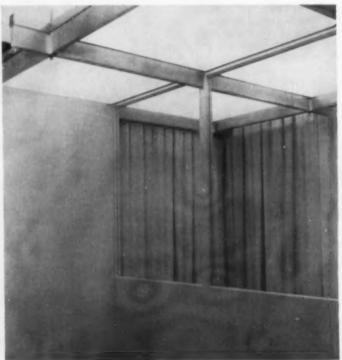
Some lighting manufacturers have developed modular lighting designs suitable for modular building design, and outstanding installations have already been made. The big problem faced by the lighting industry now is to insure that building modules selected will permit of the widest choice of light sources, lighting equipments, and ultimate lighting systems.

SOUND BAFFLES are spaced on module dimensions, are interchangeable with wall partitions.





MODULAR dimensions are necessary for lighting equipment that forms a design element in a structure incorporating a modular system of standardized dimensions. Buildings at the new G-M Tech Center, Warren, Mich. were designed around the 5-ft module, and incorporate 5-ft square moulded Plexiglas diffusing light panels.



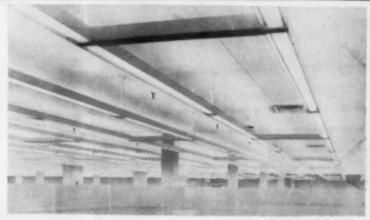
LUMINOUS CEILING of modular design permits wall partitions to be installed as desired, at intervals conforming with the module dimension.

POPULAR LIGHTING TECHNIQUES

HERE are a variety of modern lighting techniques which continue to be popular, some of which have been available for some time. Many of these are illustrated in the accompanying photographs. Combined, they still account for a big part of the total lighting equipment sold. Each type of unit, or system, has its own individual features and advantages, and many of these are outstanding quality features. For many applications, these individual features make these systems the logical and economical lighting solution.

Recessed troffer systems are one of the lighting techniques included here as a popular lighting technique. Troffers produce efficient, high quality lighting. Troffers are of two types, structurally, the shallow type and the deep type. Either type can usually be installed in the ceiling space available. Troffers are also available with various patterns of light distribution, and various types of shielding. These include glass and plastic prismatic lenses, glass and plastic diffusers, and metal and plastic louvers. Also, troffers are available in low brightness design, for both one and two rows of standard fluorescent lamps in 12-in. width units, and for one row of 40-watt 60-in. T17 low brightness fluorescent lamps. Troffers have been available almost since the introduction of fluorescent lamps, and have been used extensively for the lighting of offices and drafting rooms, and other similar applications including industrial production areas. With the many refinements that have been made in troffers in recent years, they still remain an excellent lighting tool, and the basis for most of the luminous area units which are, in essence, troffers that have been expanded in width.

Another excellent lighting technique with merit is the integrated lighting-acoustic baffle system. In this system low brightness fluorescent lamps on ceiling-mounted wiring channels provide diffuse direct lighting, and acoustical baffles provide direct shielding of the lamps as well as sound control. This system has been used primarily for the lighting of classrooms and offices, and for areas where an attempt was made to simplify maintenance.



LUMINOUS-INDIRECT luminaires with high utilization produce 165 footcandles with high visual comfort in this Los Angeles installation. Light distribution is 85% up, 15% down, from 800 ma lamps in 4-in. sq channels—ballasts in cross members.



BAFFLES shield lamps and absorb sound in this Chicago general office. Lamps are 96T12 slimlines, operated at 200 ma for low brightness, installed on 32-in. centers at center of and parallel to baffles, to provide 45 footcandles with minimum maintenance.



RECESSED TROFFERS and cove lighting light the Milwaukee Public Library to an intensity of 40 footcandles. Troffers are lens shielded and louvered. Reflected light from light colored floors lights ceiling softly.



TROFFERS with glass lens shielding are combined with air diffuser outlets in artistic and functional pattern to light this general office in Owens, III. Light finish on desk tops reduces brightness contrasts, makes seeing more comfortable.



VISUAL COMFORT Index of 97 crosswise, 86 lengthwise, Is achieved in this 65-footcandle installation in the bookkeeping department of a Milwaukee bank with low-brightness troffers on 3-ft centers, using 40-watt T17 lamps.



SUSPENDED large-area low-brightness louver units provide an abundance of well diffused illumination to light this Waukegan, Ill., paint store.



CONTINUOUS ROW 2-lamp slimline shielded luminaries provide a high quality lighting result in this Kansas City, Mo. food store, display merchandise most effectively, make shopping easier for the customers.

One of the most popular lighting systems since the introduction of fluorescent lamps has been the basic 2-lamp and 4-lamp shielded luminaire. Originally this unit was used as a standard 4-ft design, and installed as individual units. It has since developed into a continuous row system, as lighting standards have increased, and made available with various types of shielding. Both metal and plastic louvers are used, with either metal or plastic side panels. Also, this basic system is available for suspended or surface mounting, to meet varying ceiling height conditions. Surfacemounted units are available also with a variety of shielding and diffusing devices including both glass and plastic, for either plain diffusion or lens control.

A new development in this field is a prismatic plastic diffuser which adds light control to provide maximum light utilization in the zero to 45-degree zone, and minimum brightness in the glare zone.

Most of these general-diffuse type of lighting units include as part of their design a housing for incandescent reflector spot or flood lamps, for use in sales areas.

A relatively recent trend has been to very thin, but wide, surface mounted units incorporating louver or luminous shielding devices. These are used appropriately where recessing of equipment is impractical, and where very low ceilings exist.



RECESSED DOMES with bowl-silvered incandescent, lamps provide uniform illumination of good color quality throughout the Wilmette, III. branch store of Carson Pirie Scott & Co.



THIN luminaires, surface mounted, simulate recessed troffers in this Arlington, Va., bank, provide quality lighting for a low-ceiling area.



PLASTIC DIFFUSER luminaries, surface mounted and installed in decorative pattern on ceiling, light this paint store effectively throughout.



TWO ROWS of fluorescent direct-indirect luminaries provide a high level of general diffuse illumination throughout this long and narrow appliance salesroom.



LIGHT is used effectively in this shoe store to highlight merchandise for effective display, to aid in sales, and to add decorative treatment.



LIGHTING DESIGN in this Houma, La. bank is artistically and functionally integrated with the architectural design, provides 75 footcandles and cheerful atmosphere throughout.

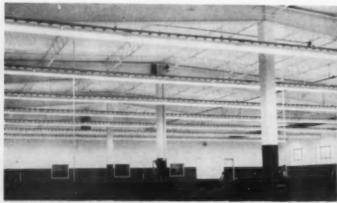
INDUSTRIAL LIGHTING



PRISMATIC GLASS dual-reflector units with intensive light distribution are installed 54 ft above floor, house 400-watt Type E-H1 mercury lamps, provide ideal illumination for this Kansas City railway shop. Work pits in floor are lighted with wall-recessed incandescent units.



ALUMINUM REFLECTORS with intensive light distribution equipped with 1000-watt, Type A15 mercury lamps light this high bay area in a large industrial plant. Incondescent lamps (see smaller units) are for emergency lighting in case of power interruption.



PORCELAIN ENAMEL continuous line reflectors with top opertures for 12% upward light component, each equipped with three continuous rows of 96T12 fluorescent lamps operated at 800 ma, provide 162 footcondles of illumination throughout the work area of this West Coast machine and metal works plant. Upward light component reduces brightness contrasts.

HE trend to better quality lighting and to improved visual environment in factory production areas, which got under way conspicuously about 1951, continues at a quickening pace. The higher quality lighting results from new light sources having improved color quality, from more and better direct shielding of lamps and reflectors, and from use of open-top reflectors or other techniques to provide an upward light component of from 10% to 50%. The improved visual environment results from the use of lighter colors and higher reflection values for ceilings, side walls, columns, floors-even lighter colors on machines, work benches, tools, etc .- which reduces brightness contrasts, and from shielding of upper portions of glass walls and windows to reduce outside sky glare.

Another growing trend is the use of higher lighting intensities in factories, especially in assembly areas where small and intricate parts are handled. Lighting intensities of 75 to 150 footcandles are fast becoming standard practice for such areas. Also, in offices and drafting rooms intensities ranging up to 250 footcandles are being installed in increasing numbers to make critical seeing easier.

Light Sources

Another contributing factor to industrial lighting progress is continuing improvements in light sources, and development of new lamps. Mercury lamps have been improved in efficiency and in color quality, and new sizes and types have been added in recent months so that now a wide range is available. Most popular sizes for industrial lighting are 400, 700, 1000, and 3000 watts, and are used principally for medium and high bay applications in suitable reflectors.

Low bay and assembly line areas are now being lighted principally with fluorescent lamps. These are housed in a wide range of types of equipment, each type designed to provide a specific type of light distribution. Reflectors are being made with top apertures for varying quantities of upward component lighting, and since this technique has come into use, general-diffuse type luminaires formerly



HIGH OUTPUT 800 ma fluorescent lamps in direct-indirect louvered units light this wood-working shop at Nela Park, Cleveland to a comfortable 250 footcandles.



400-WATT color corrected mercury lamps in porcelain reflectors provide 20 footcandles on the loading platform of this shipping and receiving area.

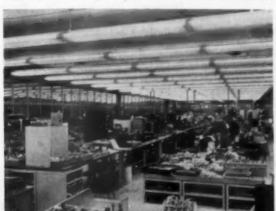


ALUMINUM two-lamp continuous row reflectors with 25% upward component of light are spaced 7 ft on centers 10 ft above floor to provide 80 footcandles on work plane, with low brightness contrast between unit and ceiling, in this Milwaukee factory. Floors and work benches are in light finish.



PORCELAIN reflector continuous row units with bottom panel diffusers provide 150 footcandles in this Culver City, Calif. plant. Units have 10% upward component of light to reduce contrast of unit with ceiling. Note also that top of assembly line benches are in light finish.

ALL-PLASTIC reflector and louver unit, of the 2-lamp continuous row type, a typical "commercial" luminaire, was used to provide a high level of illumination with low brightness contrast in this Teterboro, N. J. plant. Area is also air-conditioned.



MERCURY LAMPS in prismatic glass reflectors are spaced on 10-ft by 12-ft centers 12 ft above floor to provide an average illumination (initial) of 94 footcandles in this low bay area of a Chalmette, La. plant. Ceiling is softly lighted.





45° ANGLE mounting of 2/40-watt glass shielded reflector units on each side of assembly line provides 80 footcandles of diffused illumination over entire area, even under hoods of cars, in this Mahwah, N. J. automobile assembly plant.



DIFFUSERS of corrugated vinyl plastic are installed under two continuous rows of 2-lamp industrial reflectors in a Chicago plant, over assembly-work bench, to reduce glare of specular-surfaced products and improve seeing conditions.

considered primarily for commercial uses are quite often installed in industrial areas.

Since the introduction several months ago of the 800 ma high output lamps, they have been used extensively in industrial lighting, 1) to take advantage of their higher efficiency, and 2) to provide higher lighting levels with the same number of units. Now, with the recent announcement of very high output fluorescent lamps (25 watts per foot) it is predicted that

these lamps will prove to be very popular for many industrial lighting applications.

Use of incandescent lamps for industrial lighting are generally on the decline, except for providing low intensity illumination and for areas where dirt and dust accumulation is severe. In these areas, reflector-type lamps, or standard lamps in industrial reflectors are still being used. If lamp replacement presents a problem, 2000-hour life lamps are generally used.

Maintenance

Equipment designs are including more and more features to simplify maintenance. One such feature, being incorporated in reflectors for all types of light sources, is the introduction of vent holes in the tops of the reflectors. This creates a movement of air through the reflectors and minimizes the collection of dirt and dust. It also helps keep the units cool, which in the case of fluorescent lamps, results in higher lamp efficiency.

An ever increasing number of production areas are being air conditioned and acoustically treated. Such areas are being effectively lighted with recessed troffers, and with large-area low-brightness units, including wall-to-wall luminous ceilings, as well as with some of the older methods. A recent reflector design incorporates green color in the reflective porcelain to produce whiter and cooler light.

In high bay areas intensive type light distribution builds up high levels of illumination on the horizontal work plane. If vertical illumination is needed, wider beam spread type of light distribution helps, but usually some type of side lighting is desirable. Standard fluorescent reflectors can be installed at an angle to accomplish this, especially long assembly lines, to provide satisfactory vertical lighting.

Acknowledgements

Photos used to illustrate this 18page feature on lighting design and application were selected and supplied by some of the leading manufacturers of lighting equipment as representative of today's best lighting practice. Photos used were supplied by: Albert Sechrist Mfg. Co.: Benjamin Electric Mfg. Co.; Crouse-Hinds Co.; Curtis Lighting, Inc.; Day-Brite Lighting, Inc.; Edw. F. Guth Co.; Frink Corp.; General Electric Co., Lamp Division and Outdoor Lighting Division; Holophane Co., Inc.; Richard Kelly; Thomas Smith Kelly Lighting; Lighting Products, Inc.; Luminous Ceilings, Inc.; Marlux Corp.; Miller Co.; Peerless Electric Co.; Revere Electric Mfg. Co.; Silvray Lighting, Inc.; Smithcraft Lighting Division; Smoot-Holman Co.; Solar Light Mfg. Co.; Sylvania Electric Products Inc.; The Wakefield Co.; and Westinghouse Lighting Division.

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Transformer

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FIG. 1—Plot plan of building shows utility transformer vault, old underground conduit runs, new underground conduit run and basement layout of service and distribution equipment and meter banks. Circled letters indicate point of risers to apartments of corresponding letters on five floors of building, in accordance with apartment feeder and panel schedule shown in Fig. 4.

An engineering challenge in . . .

APARTMENT HOUSE REWIRING

Design and construction details behind a modernized distribution system—engineered to combine economy of installation and power-plus capacity for full and flexible use of heavy-duty electrical appliances throughout Tudor Hall, a large apartment house in Englewood, N. J. Busch Bros., Inc., Englewood, N. J., were the electrical contractors.

By Arthur N. Reichel, President, New Jersey Electrical

President, New Jersey Electrical Engineering, Inc., Englewood, N. J. Tudor Hall, an apartment house in Englewood, N. J., is a typical case study of work being done in the growing rewiring market. Here, the electrical distribution system and the branch circuit layout in the apartments were revamped to provide more electrical power for air conditioning and for growing use of such modern ap-

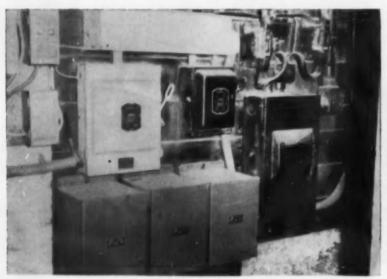
pliances as electric broilers and other cooking appliances. Design and layout of the modernized system dovetailed with the old equipment layout, effecting economies consistent with design objectives.

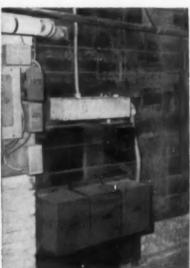
Prior to the recent modernization work, the building was supplied by two services from an underground utility transformer vault near the building at one corner of the property. One service was single-phase, 120/240 volts, 3-wire, supplying the apartments in the building. This service came from a 75-kva single-phase transformer in the vault. The second service was rated at 3-phase, 3-wire, 240 volts, supplying the owner's equipment—elevators, outside lighting, entrance and corridor lighting and other basement-located electrical equipment—from three 10-kva, single-phase transformers in the utility vault. The 2-in. and

4-in. underground conduit runs used to carry the service conductors from the vault to the building are shown in the plot plan—Fig. 1.

To meet the demand for more power and to conform with the design of electrical remodeling for the building's distribution system, the utility installed three new transformers in its vault and discontinued use of all of the old transformers. The new units supply power at 3-phase, 4-wire, 120/-208 volts for both the owner's re-

quirements and for the apartments. As shown in the plot plan, the two existing underground conduit runs were used to bring in the owner's service and service for two banks of apartment meters. Then from the utility vault, a new 4-in. conduit was run underground outside, then into the building to carry service to a third bank of apartment meters. In the old system, all apartments were served from a single meter bank adjacent to the owner's service equipment.





BEFORE (left) AND AFTER views of layout of owner's meter and transformers. Originally used for changing 240-volt, 3-wire delta power to 120/208-volts, 3-phase, 4 wire, for house lighting and miscellaneous power, transformers now change 120/208-volts, 3-phase, 4-wire to 240-volts, 3-phase delta for powering elevator motors. In old system, the 240-volt delta service from utility was brought in for elevators and power loads, with a portion of it transformed for house lighting. In new system, only 120/208-volts, 3-phase, 4-wire is purchased from utility, requiring a wye-to-delta transformation for old power load. As shown at right, owner's old metering equipment and CT's were removed.







BEFORE (left) AND AFTER views of power panel and main switch location. In the old layout, power service switch, power panel, 600-amp single-phase switch and apartment distribution panel are lined up along wall with bank of meters running from apartment feeder panel to end of a long section of wall. At center, two new utility pull boxes are mounted, in same place, one on each side of old power distribution panel which is still used. Pull box in foreground is fed up through floor by service conductors in old 4-inch conduit from utility vault. Each of two sections of 3½-inch conduit shown curving into built-up concrete envelope supplies a 200-amp, 3-pole main breaker on wall just behind column at left. Main breakers feed new meter bank "B" and are mounted alongside new owner's meter and disconnect switches. At right, new meters with 30-amp, 2-pole CB's for feeder protection and disconnect are shown on wall opposite that on which old meters were mounted. Utility pull box is shown again in background.

The old layout of equipment for electrical distribution to the owner's light and power loads and to the apartments is shown in Fig. 2. The changeover from this condition to the new modernized layout was made during normal working hours with minimum interruption of elec-

tric service. The modernized layout of distribution and metering equipment is shown in Fig. 3.

To facilitate the entire changeover to a new distribution system, a complete section on "Suggested Procedure for Maintaining Continuity of Service" was included in the specifications for the job. Typical steps set forth in the procedure are as follows:

1—New meterboards "A" and "C" and underground service entrance conduit from the transformer vault to board "A" were installed.

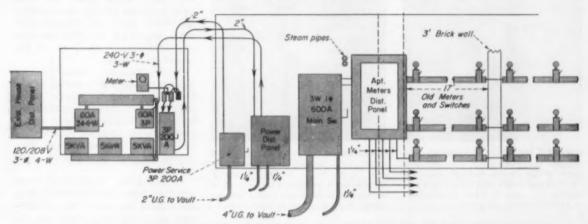


FIG. 2—Layout of old distribution and metering arrangements was built around a 3-phase power service for owner's equipment and a single-phase service for apartment feeders. Three 5-kva, dry-type transformers connected delta-primary, wye-secondary transform part of power service to 120/208-volt use for building lighting and miscellaneous equipment. One long meter bank served all apartments throughout building. 240-volt, 3-phase incoming service conductors run through a 3-pole switch, over and through current transformers and another 3-pole switch at location of 5-kva transformers, then back to a power distribution panel alongside main 600-amp single-phase switch on another wall. From this power panel, which serves feeders to elevators, a 3-wire feeder is carried in flex through a 60-amp, 3-pole switch at transformer location, into a wireway, through flex to 5-kva transformers, back in same flex to wireway, then out of wireway through a 60-amp 4-pole SN switch to house distribution panel.

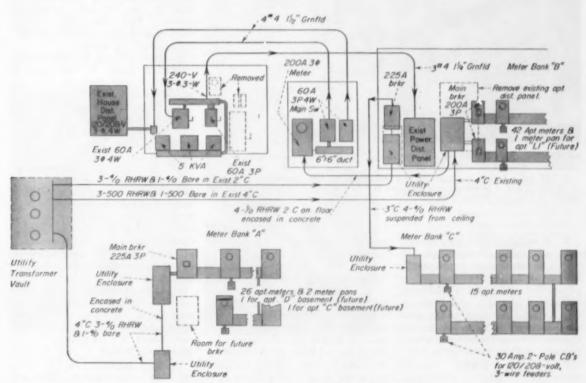


FIG. 3—New distribution and metering arrangements consist of a revision of old layout of meter bank "B" and addition of new meter and feeder layouts at new meter banks "A" and "C".



OWNER'S METER is mounted on wall opposite old power panel, with 200-amp main CB's on left side feeding meter bank "B" and disconnect switches on right side feeding flex runs to 5-kva transformers and house distribution panel.



METER BANK "C" is fed by four #4/0 RHRW in 3-inch conduit run from a 225-amp CB, as shown in Figs. 1 and 3. Armored cable feeders are shown grouped as they rise to basement ceiling and are carried to point of rise to apartments.



ARMORED CABLE FEEDERS from 30-amp, 2-pole CB's at meters are shown here from the back of the wall on which new meter bank "B" is mounted. Each feeder supplies 120/208 volts, 3-wire, single-phase, to a new panel in each apartment. Both 3/c # 10 and 3/c # 8 armored cable was used as shown in Fig. 4, depending upon the lengths of runs and voltage drop.

2—A temporary 600-amp disconnect was installed at meterboard "B" with an open-wire jumper to the main apartment distribution panel, and a temporary 200-amp, 3-phase, 3-wire disconnect switch was installed adjacent to the 600-amp switch with an open-wire jumper between the current transformers and the 200-amp switch.

3—A new 200-amp, 3-phase meter and service disconnect switches were installed and tied into the old house distribution panel and the bank of 5-kva transformers, as shown in Fig. 3.

4—A ground test was run with a Megger on the old elevator feeders to be sure there were no grounds. Such grounds would have created difficulty when temporary power was brought into these feeders from a utility transformer truck which parked close to the building to supply 3-phase, 4-wire, 120/240-volt power from a delta source connection.

5-The mains of the 200-amp

and 600-amp temporary switches were connected together and provided with coiled-up wire ready for connection to lines from the utility transformer truck at the curb. All of this work was done in accordance with arrangements with the utility company. It was set so that the four wires from the two switches were quickly connected to the lines from the transformer truck which was available for only one day, during shutdown of the transformer vault.

6—A 1000-amp, 3-phase, 4-wire secondary bus was installed in the transformer vault where three submersible type transformers were also installed. These transformers were provided with wiping sleeves, and primary cables furnished by the utility were lead-covered.

7—Secondary conductors were installed from the transformers to the bus, in the vault. The old 600-amp main service switch was removed and replaced with a utility company enclosure to serve as a pull box. New service entrance conductors were installed from this pull box to the bus in the transformer vault.

8—Temporary conductors were then installed from the utility pull box to the 600-amp temporary switch. The apartment meters were re-energized through the 600-amp temporary switch.

9—The old 3-pole, 200-amp switch supplying power to the owner's equipment was removed and replaced with a utility company pull box. New service entrance conductors were then installed from this pull box to the bus in the transformer vault, in the existing conduit.

10—A temporary jumper was installed from this new pull box to the new owner's meter. When this was completed, the temporary feed from the utility transformer truck was removed and the new transformers in the vault were energized, thereby re-energizing all existing equipment and new meter-boards "A" and "C".

11—New apartment feeders were installed from circuit breakers at meterboards "A" and "C" to new apartment panels. On the old meterboard "B", old feeders, for all apartments served by new feeders from new meterboards "A" and "C", were disconnected. Then all the remaining feeders were transferred, one at a time, to the old

Apt.	#	Room	5		Existing Cets.			partme anel Co				Fee Si	der ze		
	Bsmt.	Tst	2-5	Bsmt.	1st	2-5	Bemt.	lst	2-5	Bsmt.	1st	2nd	3rd	4th	5th
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8	3	6	7	3	4	4	6	8	8	10	8	*8	8	. 8	*8
C	*	2	5	-	2	3	-	4	6	-	10		8	8	
D	*4	-	3	3	-	2	6	-	6	10	-	10	10	10	10
8	-	4	3	-	3	2	-	6	6	-	10	10	10	10	10
F	-	*3	3	-	12	2	-	6	6	-	*8	10	10	10	10
G	-	3	3	-	2	2	-	6	6	-	10	*10	10	10	10
H	-	4	3	-	3	2	-	6	6	-	10	10	10	10	10
1	-	5	4	-	3	3	-	6	6		8	10	10	10	10
K	-	-	3	-	-	2	-	-	4	-	-	10	10	*10	10
L	-	*4	4	-	3	3	200	6	6	-	10	10	10	10	10
M	-	4	3	-	3	2	-	6	4	-	10	10	10	10	*10
N	-	_	2	-	-	2	-	-	4	***	-	10	10	10	10
P	-	5	4	-	3	3	-	6	6	-		10	10	10	10
R	-	3	3	-	2	2	100	4	4	-	10	10	10	10	10
S	-	6	6	-	4	4	-	8	8	-	8	8	8	8	
T	and a	4	5	-	3	3	-	6	6	-	10	8		8	*8

*Exceptions as below:

Apt. C - Basement - Meter pan and breaker only, no feed (for future apartment).

Apt. D - Basement - Meter pan and breaker, install 3 #10 feed but tape up for future connection to meter. Run additional 3 # 10 feed and connect to Owner's meter as at present.

Apt. F - 1st Floor - Use 2 circuits in new panel to supply 3 wire #10 feed to existing 12 circuit panel in Dentist X-ray Room.

Apt. L — 1st Floor — Meter pan and breaker, install 3 #10 feed but do not connect, extend 3 #10 feed to Owner's meter as at present.

*Replace existing panel and feeder and connect existing equipment.

NOTE: 5-room apartment feeds increased to #8 cable

Fig. 4—Apartment feeder and panel schedule, as given in specs.

meters at the right-hand end of hand end of meterboard "B" were meterboard "B"; and a temporary feeder to this end of the meterboard was run from the temporary 600-amp disconnect switch.

12-The old apartment distribution panel and all unused meters and meter equipment at the leftremoved. New meterboard "B" was installed, and new feeders were run to new apartment panels. The transfer of apartments from one meter to another was coordinated with the utility company, in accordance with the overall plan.





METER BANK "A" is shown in part at left, fed from main 225-amp, 3-pole CB shown. CB is supplied through wall behind meter bank. Immediately on other side of wall is a utility pull box supplied by three #4/0 RHRW and one #4/0 bare in 4-inch conduit from utility transformer vault. At right, a utility pull box is shown just inside building wall where 4-inch conduit run comes in. Conduit is encased in concrete for run along floor to pull box on wall behind meter bank.



TYPICAL APARTMENT PANEL, high on wall in kitchen, is supplied from armored cable feeder, run up in dumbwaiter shaft from CB at basement meter location. Armored cable feeders are shown in shaft, just inside open dumbwaiter door. Panelboard is CB type for 120/240 volts, 3wire, single-phase. Panel has six circuits, although not all are in present use, and two blanks. Circuit conductors are run from this panel to old panel where connections to old circuits are made and where new circuit runs originate. In each apartment, all circuits are tied into new panel. Conductor runs from new panels to old panels were made in surface raceway in some apartments and were type UF cable, surface mounted, in other apartments (shown here). Clean finish and appearance of white jacketing on type UF made it effective in this installation, matching finish of ceilings and walls.



THE SACHS ELECTRIC crew puts finishing touches on the main substation. This is the key source of power for the entire Mid-America Jubilee.

ELECTRICAL NOTES on

MID-AMERICA JUBILEE EXPOSITION

Power and lighting systems for a St. Louis, Mo., exposition was installed by Sachs Electric Corp. to serve the requirements of participating industrial, agricultural, commercial, and theatrical interests with sufficient capacity to serve a city of 7500.



SECONDARY SWITCHES in one of 24 substations at the Mid-America Jubilee grounds in St. Louis.

THE design and installation of a complete electrical system to meet the varied power requirements of industrial, agricultural, commercial and theatrical interests who participated last month in the first annual Mid-America Jubilee on the St. Louis riverfront, presented a formidable challenge to the contractor, Sachs Electric Corp. of St. Louis.

The completed system for the Jubilee, a major exposition of regional scope, has sufficient capacity to serve a city of 7,500. More than 65 miles of wire and cables, sizes 14 to 400 with 600-volt to 5,000-volt ratings, were required. Mid-America Jubilee is located on a 37-acre section of the Mississippi

Riverfront area which was cleared several years ago in preparation for the eventual construction of the Jefferson National Expansion Memorial, a federal project. The site was selected for the Jubilee because of its ample parking area and the proximity of the Mississippi, symbolic of the city's expansion.

The choice of location necessitated starting from scratch so far as the design of an electrical system was concerned. Project engineer Norman L. Krause, a vicepresident of the Sachs firm, recalls that the Mid-America Jubilee management could not specify its needs in advance. When construction began last spring, the planning and promoting of the imaginative event was still under way. As far as general layout and needs were concerned, the problem, according to Krause, "was the same as planning the wiring for a small community."

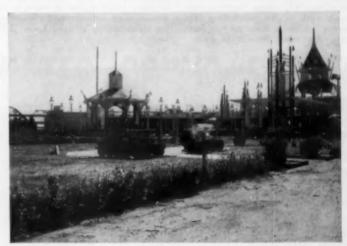
The contractor's first problem was to provide adequate power to the exposition's varied (and at the time of construction largely unknown) needs "in as economical but as unobtrusive a manner as possible" to use Krause's words. Economy, safety and design dictated that the system be almost entirely underground. Overhead wiring, Krause estimates, would have cost about twice as much. Conservative estimates indicated at least half a million attendance during the month. Unsightly overhead wires would conflict with the Jubilee's colorful, contemporary design.

Furthermore the wiring also had to be of a permanent nature. Plans call for holding the Mid-America Jubilee each September to dramatize the economic-social interdependence of the region's rural and urban populations and to stimulate business in the Greater St. Louis area. The Mid-America Jubilee was underwritten by a nonprofit organization, City-Country Cavalcade, Inc., sponsored by the local chamber of commerce. A professional executive staff manages the exposition.

Mid-America Jubilee power is supplied by the local utility, Union Electric Co. A primary 4160-volt, 3-phase, 4-wire power line goes to the main Jubilee distribution plant where a disconnect switch and a main oil-filled breaker protect the utility feeder. From this point there are three protected primary feeders supplying power to 24



OLD-TIME WIRING 1904 vintage is used by the Sachs electricions in the beer garden and restaurant. Photo shows workmen installing old-time lamp posts which were used throughout this area.



ONE OF 65 SIDEWALK LIGHTS made especially for the Mid-America Jubilee can be seen in foreground at edge of roadway. The exposition's old fashioned beer garden is in background.

strategically located outdoor substations. These substations are attractively camouflaged to blend with the Jubilee decor.

Each substation contains one or more primary fuse cutouts, one or more oil-filled transformers and necessary outdoor secondary distribution panels. All of the equipment was set on a concrete pad which had been poured on the ground. (The Sachs firm placed four angle-iron posts in each pad. not knowing at the time what equipment might later be required.) After the concrete had been poured and the equipment installed, a metal partition, open at the top, was set around the perimeter of the pad. Double doors on one side of each of the 12- by 18-ft substations permit easy access to the equipment. The metal exteriors of the substations were painted with gray and white vertical stripes.

To meet power requirements, secondary distribution panels at the Mid-America Jubilee are of the convertible type. Switches of various sizes can be used up to the capacity of the panels.

The transformers, which are of the outdoor, oil-filled type, completely self-filled, were rented from Union Electric along with the main oil-filled breaker. This equipment is removed after the exposition is over and is to be re-installed next summer prior to the 1957 opening.

One of the many interesting problems which occurred as the 60man Sachs crew wired the six main

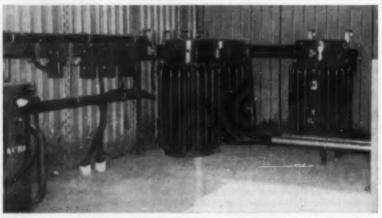
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A LIGHTING PANEL BOARD on the exterior of exhibit buildings. Electrical maintenance work at the month-long Mid-America Jubilee is done by two Sachs Electric electricians, three shifts daily.



LOUIS SACHS stands by pylon light, one of many which is used at night to light Mid-America Jubilee. Light goes straight up inside plastic covered tower, 5,000 watts.



THREE TRIPPING TRANSFORMERS, cutouts to protect feeders. A typical substation at the Mid-American Jubilee.



INSIDE THE GEODESIC DOME at the Mid-America Jubilee is a typical lighting panel to be found in each of the exposition's buildings.



NORMAN L. KRAUSE of Sachs Electric Co. points to details of old-fashioned wiring used to give authentic atmosphere to Beer Garden-Restaurant.

buildings and the many smaller exhibits, walks, parking lots, concession stands and other units, was the wiring of the Jubilee's authentic, old-time outdoor beer garden. To simulate the atmosphere of 1904, the year St. Louis celebrated the 100th anniversary of the Louisiana Purchase with its World's Fair, Krause and his crew followed every detail closely. Thirty gas lamps were imported from Baltimore, converted to electricity, using a knob, tube and cleat arrangement.

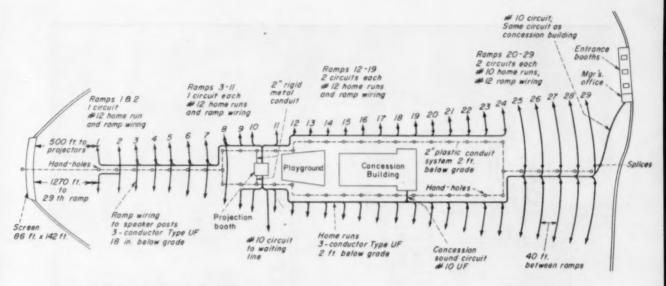
Another problem, finding a satisfactory sidewalk light which would withstand the rough handling one might expect from large crowds, was solved by designing a 32-in, standard from a conventional bracket light turned on its side. There were 65 of these varicolored fixtures installed.

Down the center of the floor of each main exhibit building Sachs ran a concrete trough in which several conduits have been run from the panelboards in the buildings. A wooden cover matches the floor, but can be lifted easily for electrical floor work. A 21-in. wireway has been run across each ceiling for spot lighting. Inverted industrial fixtures provide indirect illumination. From the floor troughs outside lamps have been connected to light the buildings' exteriors. There are several exhibitors in each building and the arrangements permit flexibility in power available.

The Sachs Corp. also installed wiring for nine separate speaker paging systems which can be used also as a unit for general announcements. This wiring is also underground, usually in the same trenches with the power feeds. Wave trap filters are used so no hum is transmitted over the speaker system.

Other wiring included that for the exposition's theater, an outdoor amphitheater facing the historic Old Cathedral (1834), one of the few buildings preserved in the Jefferson National Expansion Memorial razing a few years ago. With a church as a backdrop, its portico expanded into a large stage, shows were held daily in the afternoons and evenings before crowds up to the seating capacity of 4,500. Special lighting effects were handled by the firm of Otto K. Olesen Co., Hollywood, Calif.

A maintenance crew of six men, working in two's in three shifts daily handled routine matters during the 30-day exposition.



Type UF direct-burial cable serves

DRIVE-IN THEATER SOUND SYSTEM

with plastic conduit as standby raceway

Installation uses more than 2500 speakers using 100,000 feet of 3-conductor Type UF cable, with 2000 feet of 2-in. plastic conduit in place for future addition or replacement of circuits.

By William Miller, Engineer, M. Eisenberg and Bros., Inc.





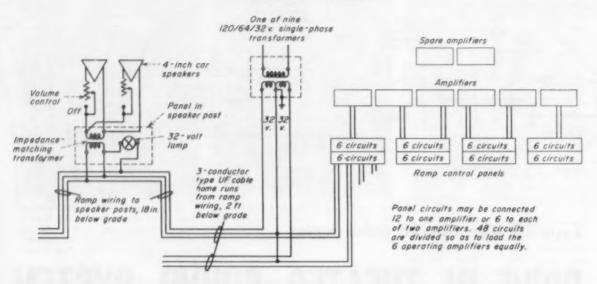
HAND-HOLES formed by U-shaped concrete blocks (left) were placed at all open joints of plastic conduit to provide access to conduit. Masonry was split where conduit sections met at right angles. Masonite cover over completed hand-hole (right) protects open conduit ends from fill, Metal outlet box cover nailed to masonite makes it possible to locate hand-holes after back-filling by means of metal-detector.

WITH an eye to the future, M. Eisenberg and Bros. Inc., electrical contractors of Brooklyn, N. Y., supplemented 100,000 ft of Type UF sound circuits with a complete system of empty 2-in. plastic conduit at Century's 110 Drive-In Theater in Huntington Township, L. I., N. Y., the world's largest drive-in using a single screen and projection system.

The conduit was buried 2 ft below ground alongside the sound system home runs to provide a convenient means for adding new cable should trouble develop on the original circuits, the defective cables being left in place.

Speaker posts are fed by 8-conductor Type UF direct-burial cable.

SOUND SYSTEM WIRING



SOUND CIRCUITS originate in projection booth, fed by six 125-watt amplifiers through four ramp control panels. Each amplifier is capable of feeding 500 speakers. Each of the 48 circuits (12 per control panel) is controlled by an on-off switch on the panel. When the switch is turned to its "off" position, a resistance is thrown across the line which approximates the normal speaker load on that circuit. Thus one or more ramp circuits may be turned off without affecting the normal output of the amplifiers. The 12 circuits in each ramp control panel are so arranged that they may be connected all to one amplifier or 6 to each of two amplifiers. Thus, by observing variations in number of speakers per circuit, each amplifier may be loaded closer to its rated capacity, and a better division of load between amplifiers may be effected. Two additional amplifiers identical to the six in use are available as spares for emergency use.

A typical load on one of the amplifiers consists of

12 circuits in parallel, each circuit feeding an average of 20 speaker posts, two speakers per post. Fitting into the housing at the top of each post is a small panel on which is mounted an impedance-matching transformer, a 32-volt lamp and appropriate terminals for making connections between the equipment and the line. Two speakers, each with its own volume control, are paralleled across the transformer secondary. A colored plastic cap fits over the post housing and serves to indicate its position in the dark, being illuminated by the lamp.

Note that the lamp and sound circuit use a common wire, the common being connected to the sound system ground, as is the center tap of the 120/32-volt transformer secondary feeding the post lights. An equal number of lamps are connected to each "hot" leg of the transformer secondary to eliminate any current flow in the common conductor. The transformer also has 28-volt taps for use on shorter circuit lengths where voltage drop is not substantial.

Home runs, No. 10 or 12 depending on circuit length, are 2 ft below grade; lateral ramp wiring in either direction from the home runs is 18 in. down, looping up into each post. Either one or two circuits were required for each ramp, varying with the number of posts in the ramp.

An additional No. 10 circuit was run to the waiting line along one side fence of the theater, where 34 extra speakers were installed to accommodate cars not able to find space along the ramps. Another No. 10 circuit feeds speakers in and around the concession building and the manager's office at the main entrance. A total of 2560 4-in. speakers were used for the installation.

The standby plastic conduit was accepted by the owners, realizing that otherwise a fault would first have to be localized and exposed (requiring special equipment), the

cables dug up, and the defective cable identified and repaired. This could result in damage to other cables from digging, there being as many as 25 cables in the same trench. Replacing or adding a cable would require a new trench from the projection booth to the ramp involved, a distance which could be as great as 760 ft.

To replace a circuit using the plastic conduit, it will be necessary only to locate and uncover hand-







RAMP WIRING consists of No. 12 or No. 10 Type UF cable 18 inches below grade, looped up into each post (left). Speaker posts are anchored by $1\frac{1}{4}$ -in, angles welded to side of post. Small panel fitting into housing at top of post (center) mounts 32-volt lamp and impedance-matching transformer. The two rubber-jacketed cords are speaker feeds. Completed installation (right) shows two speakers mounted on post brackets. Plastic dame over post housing is illuminated by lamp to indicate post position in the dark.



RAMP CONTROL PANELS provide on-off control of speaker circuits. UF wires, stripped of sheathing, rest in trough above panels; vertical nipples connect 120/32-volt transformers.



TRENCHING for sound circuits was accomplished with a back hoe mounted on the rear of a jeep. Speaker post with attached angle iron support lies in foreground.

holes between the projection booth and the affected ramp, fish in a new home run, and make connections to the ramp wiring at the first speaker post. If the trouble is in the ramp wiring, it will of course be unnecessary to run a new circuit, since the fault can be localized easily between two speakers.

Conduit was laid in 40-ft lengths, each length made up of two 20-ft sections joined at the center with a plastic sleeve. A gap of several

inches was left between the 40-ft lengths to facilitate access to the conduit at each ramp, the opening being protected from the fill by a handhole made up of two pieces of U-shaped concrete block with a masonite cover. An outlet box cover fastened to the masonite makes quick location of the handhole possible by means of a metal-detector. Access to the plastic conduit system from the projection booth was provided by 2-in. rigid

metal conduit terminating in wiring troughs within the booth.

The cost of the plastic conduit was equal to that of rigid metal conduit, but large labor savings were realized. In addition to the light weight and ease of handling, the 40-ft sections required only one joint instead of three, no threading or reaming was necessary, and the relatively inexpensive concrete block handholes made junction boxes unnecessary.

Selecting Low-Voltage Connectors

A resume of technology of connectors used for terminating and splicing wires and cable—covering selection and application data for electrical contractors and design engineers on the wide range of low-voltage connectors in use today.

By Martin D. Bergan, Engineering Technical Director, The Thomas & Betts Co., Inc., Elizabeth, N. J.

ACH of the many different types of connectors available is just right for a particular low-voltage splice or termination. Matching the right connector to the job is of importance to the performance and durability of the circuit. The proper choice rests on a knowledge of the four "C's": the Code, the Conductors, the Connectors and the Contacts.

The Code

The Code, of course, is the National Electrical Code. It sets minimum safety standards to protect

people and buildings from electrical hazards. In relation to low-voltage splicing, the Code is of interest because of its prohibitions and its tables of current-carrying capacities of various conductors.

Some areas have their own variation of the Code. Consideration of an electrical installation should include reference to the local standards. Since the Code's provisions are based on the work of the National Board of Fire Underwriters and the Underwriters' Laboratories, a contractor may be assured of meeting its standards by using UL approved components.

Stranded Electrical Conductor Standard concentric 37 Strand 813 dia 500 MCM Solid conductor 705 dia 500 MCM (not illustrated) Lay of strands

FIG. 1—Cable construction is a factor in connector choice. Upper left and bottom figures show few contact points between strands and layers. The type connector which produces wide contact areas, as shown in upper right figure, between adjacent strands and adjacent lays should be used.

The Conductors

A second consideration in choosing a connector is the kind of conductor involved. This topic breaks itself into four parts: copper conductors, cable construction, aluminum conductors and multiple conductors.

Copper as a conductor is easy to connect. It is a good conductor and poses few problems. Of all metals except silver, it has the highest conductivity, and it possesses good mechanical strength. Small solid copper wires can be terminated with a loop under a screw head. Larger copper cables can be joined by almost any mechanical connector which exerts pressure without actually damaging the conductor.

Copper oxidizes, but slowly. The oxide film when thin has little effect on pressure type connections. It is easily broken down mechanically, and fluxes keep it from forming during soldering. The normal contact between strands in a cable is sufficient to distribute current load through all the strands.

Cable Construction

How cables are stranded is an important factor in the choice of connectors. Fig. 1 shows a typical 500 MCM, 37-strand cable, composed of three layers around a single core. In the diagram at the upper left each wire touches its neighbor in the same lay at only one point. Current passes from one strand to another through these points. At the right is a compact cable with nearly all air squeezed out. The contact points between adjacent strands and between adjacent lays have been broadened

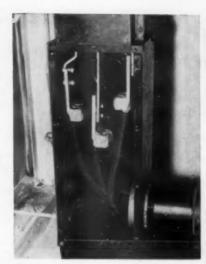


FIG. 2—Single-tongue, double-barrel lug takes two cables.

into wide contact areas. Ideally this is the way the strands of a cable should look inside the barrel of a connector or terminal. The connector contacts each strand in the outside lay, and because the strands are pressed so intimately in contact with each other, each strand carries its share of the load.

The inter-lay contact is of little consequence in working with copper cable. When connecting aluminum cables, however, it is of great importance.

Aluminum Conductors

Difficulties with aluminum arise when it is treated as if it were copper, instead of in the special way that aluminum requires. Aluminum is different from copper in four ways that affect electrical connections: (1) oxide film, (2) thermal expansion, (3) electrolytic action, (4) plastic flow.

Unlike copper, aluminum is normally covered with a thin invisible aluminum oxide film. It forms immediately when aluminum is exposed to the air, and each strand in an aluminum cable is insulated with this tough film.

What is the effect of the insulating film? Imagine 37 pieces of enameled copper wire stranded into a cable. Transfer of current between strands and lays would be almost nil. Even if outside strands were scraped clean and the cable put into a connector, they would be the only ones that would carry current. For the cable to work to capacity, insulation would have to be

cleaned off all strands or sufficient pressure exerted in the connector to break through the insulation. Such is the case with aluminum cable. This characteristic of aluminum conductors demands two requirements for good aluminum connectors.

- They should exert enough pressure on the cable to break through the oxide film.
- They should exert approximately equal pressure on all strands.

Connectors with insufficient pressure and insufficient contact sometime work satisfactorily on cables not loaded to capacity. The outside strands carry most of the load; the inside strands loaf. When the load increases, the connectors usually burn up.

Thermal expansion is the second significant characteristic of aluminum. Both copper and aluminum expand under heat, but aluminum expands 38% more than copper. When they cool, aluminum shrinks more—38% more. A copper connector and a copper cable expand and contract together. An aluminum connector and an aluminum cable behave the same way.

A copper connector on aluminum cable however can cause trouble. As the temperature increases, the cable expands more than the connector. The pressure is tremendous, and the aluminum extrudes. When the joint cools, the aluminum, having extruded, is smaller in diameter, and the copper connector no longer fits. This cycle is repeated every time the temperature of the joint changes. The difference in expansion is sufficient enough to make a loose connection and a high-resistance joint. For the best electrical performance connectors that have the same coefficient of expansion as the cable should be used.

Electrolysis is another consequence of copper on aluminum. Aluminum with copper forms a miniature wet cell in the presence of moisture. More positive than copper, the aluminum is eaten away and corroded by this action. Such corrosion impairs the electrical contact and prepares the way for eventual failure of the joint.

Sometimes it is necessary to splice an aluminum cable to a copper cable. A satisfactory method of making this joint is to use an aluminum connector designed for

aluminum. The arrangement should have the aluminum end above the copper; copper salts draining over the aluminum may cause corrosion. A final precaution is to seal the joint with an oxide inhibitor or petrolatum against moisture and corrosive atmospheres. Oddly enough, an aluminum connector on copper cable works fairly well, but a copper connector of the same design will not work on aluminum cable.

The fourth characteristic of aluminum is its tendency to extrude under pressure-plastic flow it is called. This tendency dictates two requirements for aluminum connectors. First, they should compress the cable all around for equal pressure on all strands. Good aluminum connectors should be designed for the particular cable size on which they are to be used. Connectors for a range of cable sizes do not give uniform pressure on all strands. The second design requirement is that pressure contact surfaces be long, generally twice as long as those required for copper in order to spread the pressure over a large area of cable. If the pressure should be concentrated on a small area, the cable might extrude at that point.

Multiple Conductors

Economies in using multiple conductors and convenience of han-

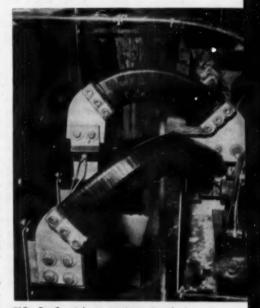


FIG. 3—Special connectors terminate three conductors in each lead of the installation.

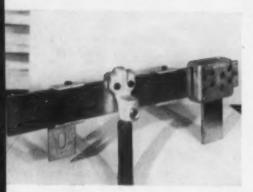


FIG. 4—A grounding system for a transformer vault uses a bolted type connector. Reliance is placed on the heavy current-carrying capacity copper bus instead of depending strictly on the raceway and the conductor. The bolted connector attaches the equipment lead to the bus and provides a suitable grounding connection.

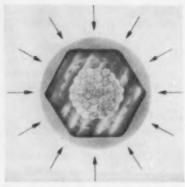


FIG. 5—Superimposed illustration shows almost solid mass of a stranded cable in a compression connector. Arrows indicate direction of compressive forces all around connector body. Hexagonal form reduces diameter of the connector, forcing strands of the conductor tightly together for good contact and a secure joint.

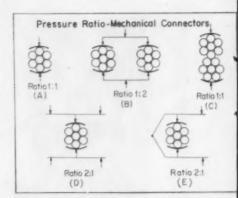


FIG. 6—Five principles of applying pressure in connector by screws and balts.

dling the smaller cables recommend them for some installations. When using them, the contractor can make his choice of connectors from among those especially designed for multiple conductors.

Fig. 2 shows a multiple conductor system, two wires in each phase, feeding from a conduit system into a 3-wire bus duct, which is a main feeder bus through an industrial plant, The connectors here have a single tongue with a double barrel for accommodating two cables. With two cables in parallel, a double barrel lug makes it easy to keep both cables the same length, so that they will share the load equally. Fig. 3 shows special connectors for low-voltage, highcurrent feeders to an electroplating barrel tank.

Connectors

Connectors for low-voltage joints fall into two broad categories, the solder and fusion connectors and the mechanical connectors.

Soft soldering with tin-lead alloy solders is about the oldest connection method. Soldering large-sized cables demands special skills. A disadvantage with even a well done soldering job is the alloy's weakness under high temperatures. It is not uncommon for the cable in some circuits to reach such a high temperature that the solder in the connectors softens, even melts, allowing the cable to slip from the terminal.

Hard solders of the silver alloy type require temperatures of over 1150°F, to flow, a temperature that exceeds the heat to which copper cable may safely be exposed. The cable's physical properties are destroyed to the point where it will break with merely a few bends.

Soldering aluminum requires more skill than soldering copper. Oxide film is the problem. It is best done with a de-oxidizing inert gas flame. Available fluxes for aluminum solders are corrosive and should never be used where the soldered connection is outdoors or in a moist atmosphere.

Welding splicers and terminals to aluminum cables gives joints of superior corrosion resistance. No fluxes are used. Melting of the welding materials, the cable strands and a portion of the connector into a unified piece of metal is the desired end, one not always achieved. Although the joint may look satisfactory, some strands may not be welded. Welding must be done within a flame shielded with inert gas.

Soldering and fusion methods are good:

- 1. if the cable is thoroughly clean,
- 2. if unused flux is not left in the joint to corrode it,
- 3. if the solder flows to all parts of the connection,
- if the workmen have the required skill,
- 5. if the wire is not weakened from annealing.

Among the various types of presure solderless connectors is the set screw connector. The screw in this type connector is tightened on the cable with no protection against the tip marring strands.

Variations of the screw type connector are shown in Fig. 6. A shows a connector with a clamp as part of the screw to act as a cushion and supply wide pressure. D shows a multiple-bolt clamp, consisting of a body and a cap. A row of bolts is on each side. When tightened, they supply strong pressure on the cable because there is a two to one ratio of cable pressure to bolt pressure. It is used mostly on tubular bus bars and stranded cables. The multiple-bolt clamp connector comes in two types: one to cover a range of sizes and one to hold a single wire size. Both are suitable for copper. Only the single wire size design is acceptable for aluminum cable. A major drawback of the multiple-bolt clamp connector is its bulkiness.

A parallel groove clamp, shown in B of Fig. 6, has poor contact pressure, but it is convenient for such work as tapping in gutters or in junction boxes. E shows the hinge connector. Limited in range, it is best suited for a single cable size. The connector fits tightly, and it may be used for either copper or aluminum cable.

The split-bolt connector, illustrated in C of Fig. 6, has proved itself for many years in tapping copper conductors. It is however, unsuitable for aluminum, giving poor distribution of current to all strands.

Another type mechanical connector is the wedge cone connector. Long in use, it is now being superseded by connectors that are

(Continued on page 280)

BID SPREAD

A marked spread in electrical quotations does not always indicate "wild" bidding. The following discussion highlights some of the basic reasons for bid variations.

By Ray Ashley

Research and Consulting Engineer, Oak Park, III.

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FIG. 1—Below normal bid of contractor "A" has low labor because better mechanics are available and overall cost is low because he felt justified in using reduced markups.

A MARKED variation in bids for electrical work does not necessarily mean that bidding is "wild" or careless. I have studied many cases where a wide spread existed between submitted prices and found very few instances that could justifiably be termed wild bidding. Often, it is a case of the low bidder being just a few jumps ahead of his competitors.

There are four common causes for a wide variation in bids. These include the following:

- 1. Condition of a contractor's business
 - 2. Faulty markups
- 3. Resourcefulness of individual contractors
 - 4. Rushed estimating.

Condition of Business

Bidding is naturally affected by the condition of the individual contractor's business. The man who has jobs nearing completion and nothing ahead will, out of necessity, figure more closely than his competitors who have plenty of work on their books. Variations in bids from contractors representing these two positions may seem startling on the surface. However, when carefully studied, they are found to reflect normal procedures.

To illustrate, let us set up a hypothetical case. "A" represents a contractor in need of business and "B" a contractor with plenty of work. They are bidding on a job that would normally have an estimated base cost of \$10,000 with a 60/40 ML ratio (base cost 60% material and 40% labor). The base costs would be \$6000 for material and \$4000 for labor.

"A" soon will have his better mechanics available and with ample engineering and supervision he can cut the normal labor down by at least 5%. He has \$3800 for the estimated cost of labor instead of the normal \$4000.

Contractor "A" also is willing to use some of the reserve that has been set aside for dull times. Instead of the normal overhead markups of 10% and 35% for material and labor respectively, he uses 5% and 25%. For return he adds 5% to material and 10% to labor.

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FIG. 2—Above normal bid of contractor "B" reflects higher labor and overall cost. Carrying additional jobs would be costly because his organization is tied up with existing work.

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FIG. 3—Normal bid estimate for work figured by contractors "A" and "B". Note material and labor totals and percentages applied to each.

hand, is not anxious to get the work, but feels obliged to furnish a price. He tells his estimator not to figure too closely because their labor situation is not good, and additional work would interfere with existing jobs.

After hurrying through the job, B's estimator comes up with estimated costs of \$6300 for material and \$4200 for labor. To make sure the labor is ample, "B" adds another \$200. Markups of 35% and 10% are applied to labor and 10% and 10% to material.

The accompanying Figs. 1 and 2 show the estimates as prepared by contractors "A" and "B" respectively. Fig. 3 gives the amounts that would normally be used in estimating the job.

Final estimated costs, as shown are:

Contractor B...... 15,125.00

Normal estimate... 13,710.00 Contractor A's bid is \$2,525 or 16.7% less than contractor B's. There is a substantial gap between the two bids, yet from the standpoint of good business practices, there is nothing radically wrong with either.

A's bid is \$1,110 below the normal estimate. However, there was a \$200 saving in the base cost of labor. To this must be added the markups of 25% and 10%, plus the allowance for insurances and job expense of \$40 plus 5%. The total savings on labor and labor services adds up to \$317.

Deducting \$317 from \$1,110 leaves a balance of \$793 which represents the amount that A's bid is actually lower than it normally would be. In percentage the bid is approximately 5.8% lower than normal. This amount would still further be reduced if the normal allowance of 0.75% for reserve were deducted.

The individual contractor must decide just how and when to use his reserve. Business may be good for the majority of contractors, but very poor for a limited few. Therefore, the contractor must regulate his markups according to his own business and not according to the general trend of business.

Faulty Markups

Readers of "Electrical Estimating" (McGraw-Hill Book Co.) are familiar with the effects of faulty and unbalanced markups. For those not familiar with the necessity of separate markups for material and labor, a brief explanation will be given.

On a dollar basis, it costs much more to supply labor services than it does to supply material. A study of the markups used in Fig. 3 will indicate the relative proportions.

On a job with a 60/40 ML ratio, the final figure (neglecting insurances and job expense) will be the same with divided markups of 10% and 10% on material and 35% and 10% on labor, as it will with a common markup of 20% and 10% on both material and labor. On a job with labor in excess of 40%, a common markup produces a figure which is too low. With labor less than 40%, the final figure would be too high.

Contractors have a tendency to cling to the common markup method of pricing estimates. As long as they are figuring complete installation jobs with ML ratios close to 60/40, the results are accurate. When figuring jobs with other ratios their estimates are likely to be out of line.

A few years back, figures were taken on a two-story bus terminal and store building to be erected in Chicago's Loop district. There was much talk about the dangerously low price for which the electrical contractor took the job. I happened to be very familiar with the electrical requirements of this project. The purchase price of equipment and materials to be supplied greatly exceeded the estimated labor and the price received for the installation was remunerative. The contractors contacted had used a common markup. No doubt, the successful contractor had figured his material and labor separately.

The recapitulations in Fig. 4 indicate the difference which common and separate markups can make on a final estimate. In this case, the project had an 80/20 ML ratio (80% material and 20% labor). Use of a common markup produces a price which is \$10,100 too high. Had the ML ratio been 20/80, the price would be \$9,100 too low.

Contractors' Resourcefulness

Regularly we find the so-called wild bidder proving that he is just a little smarter than the other contractors on the bidding list. He can use tools and scaffolding to a better

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FIG. 4—Effect of markups on estimates for a \$100,000 base cost, 80/20 ML ratio job. Estimate I gives the proper figure. Use of a common markup makes Estimate II \$10,100 high. Had the ML ratio been 20/80, Estimate II would have been \$9,100 low.

advantage; schedules his work better; selects his crews more carefully; makes arrangement with builders for clear floors; devises improved methods and does any number of other things that keep costs down.

One weakness among many contractors is a desire to keep the door open for shopping around if they get the job. They do not want to be bound by commitments to any jobbers or equipment men. By doing this, they are closing the door against getting the job, because they do not get the better prices.

Contractors complain about vendors and vendors complain about contractors. We know that in many cases the complaints are justified. However, when they do get together, they both have a better chance of making a sale.

Rushed Estimates

Occasionally, the low bid is a faulty one resulting from rushed estimating. However, among the better estimators, bids rushed to completion are likely to be high. To play safe the estimator is generous

with his allowances for quantities and contingencies and figures his labor somewhat above normal. The result is a final price which is appreciably above one that close estimating would produce.

Regardless of the causes, several high bids make the normal and correct bid look low.

Study Low Bids

Not all contractors discount their competitors' low bids. Instead many of them try to find some reason for their being low. They review their own estimate and, if satisfied it is right, other steps are taken. If relations with the low bidder warrant, they contact him and compare estimates and notes.

Out of numerous jobs reviewed and studied, there may be only a small percentage that yield any worthwhile information. However, the material gleaned from the few may be extremely valuable. Besides, every contractor should take inventory of his methods and practices from time to time and a wide spread in bids serves as a good tool to spur him into getting started.

RESISTANCE SPACE HEATING

VS-

FUEL-FIRED SYSTEMS

Data gathered in the Pacific Northwest and reduced to a common denominator speaks favorably for heating by electricity.

By J. C. Beckett, Wesix Electric Heater Co., San Francisco, Calif.

THE CURRENT increasing acceptance of electricity in the American home as an energy source for space heating indicates consumer recognition of the popularly ascribed advantages—noise-less operation, cleanliness, flexibility of control, etc—but also implies that operating costs as compared with those of fuel-fired systems are entirely reasonable and acceptable.

Research studies conducted by electrical utilities of the Pacific Northwest plus accumulated information from equipment manufacturers and a few eastern utilities make possible a quantitative appraisal from which general inferences may be drawn.

Three principal factors govern the relative annual energy costs of any given heating systems under otherwise equal operating conditions: (1) the local energy rate, (2) the efficiency with which the energy is converted to heat, and (3) more-or-less intangible characteristics of the system affecting energy consumption which may be generally accounted for by an assigned "utilization factor".

The energy rate is readily defined as cents per kw-hr of electricity, cents per 100 cu ft of gas, or cents per gal of oil. Industryaccepted efficiency values for gas and oil systems are available, while the conversion of electricity to heat is accomplished entirely without loss. The third item, the utilization factor, takes into consideration the disadvantages inherent in a central heating source. Studies have revealed that approximately 50% more energy is consumed by a central unit than by individual room units in heating equivalent homes. Careful performance tests have found the major cause of energy consumption other than duct losses to be the inability of one or two centrally located thermostats to reconcile individual room heating problems (large glass areas exposed to the sun, use of appliances, etc) with a resultant over-heating of such rooms. Considerable overshooting also occurs during highertemperature daylight hours due to heat stored by system and structure during lower-temperature night-time hours. Thus, if individual electric room heaters are assumed to have a utilization factor of 1, the factor for central systems may be taken as 1.5 to reflect the additional 50% energy used.

These three values—energy rate, efficiency and utilization factor—have been used in Table I to determine the amount of effective heat which can be expected from an ex-

Table	1.	Energy	Equivalents,	Pacific	Northwest
10000			adai. mionico		

Energy	Type	Energy	Rated	Conversion	Utilization	Effective
Source	System	Rate	Btu/cent	Efficiency	Factor	Btu/cent*
Electricity Natural gas	Unit Central	1¢/kw-hr 11½¢/100 CF	3412 9550	100%	1.0	3412 4460
Oil	Central	16¢/gal	8760	60 %	1.5	3520
Propane	Central	18¢/gal	5120	70 %	1.5	2380

*Effective Btu/cent = Rated Btu/cent x conversion efficiency

utilization fac

Estimating Constant

In estimating annual consumption of electricity for heating, it is necessary to reconcile various recognized values for the constant C in the NEMA formula*:

kw-hrs = kw heat loss x degree days x C design temperature difference

NEMA proposes use of the value 18.5; however no variations are suggested to reflect small differences observed between the several types of resistance heating systems. Experience in the Pacific Northwest indicates that appropriate values range lower than 18.5, as follows:

		e to be ected	Practical Average
Wall convector units	8	to 16	12
Baseboard units	10	to 18	14
Wall fan units	10	to 18	14
Ceiling panels	12	to 19	15
Central forced air	19	to 24	22

The value 12 has been used in computing the electrical costs of Table II.

penditure of 1 cent for energy from various sources. Equivalent values of effective Btu for other areas of the country can be worked out by revising the rated Btu to correspond with local energy rates.

The effective Btu values of Table I have been used to calculate the annual energy costs shown in Table II for heating a typical modern

single-floor home with large glass areas, further described beneath the table. Cooling costs are included to put the heat pump on an equal basis for comparison with the other systems. Note from the totals that the heat pump, while reasonably in line with other systems where both heating and cooling are involved, is obviously much

more expensive to operate than the others when used for heating alone.

While the total annual costs shown may vary due to differences in estimated installed costs, maintenance, etc, the figures serve to show that resistance heating compares very favorably in cost with other systems for equivalent homes in the same area.

Table II. Annual Cost Estimate,' Pacific Northwest

ance ^a Pump ^a Go	tural O		Resist-			
Fauinment \$800 \$2800 \$1			ance with Air Cond.	Heat Pump	Natural Gas with Air Cond.	Oil with Air Cond
Fouriement \$800 \$2800 \$15	Ini	itial Co	ost			
Edulation 1	000 \$13	300	\$2000 200	\$2800 300	\$2000 300	\$2300 350
	An	nual C	ost			
Energy \$198 \$111 \$ Depreciation' 32 187 Interest ² 20 78 Taxes ³ 16 62 Maintenance 1 22	152 \$2 67 30 24 15	204 87 39 31 17	\$238 112 55 44 9	\$151 187 78 62 27	\$192 134 58 46 23	\$244 154 67 53 25
Total Annual Cost \$267 \$460 \$						

Equipment only; straightline depreciation assuming 25-year life for resistance heaters and 15-year life for others.

^{*}See Electrical Construction and Maintenance, August, 1936, page 65.

^{2.} Equipment and space; 20-year mortgage.

^{3. 40%} value, \$5 per \$100 valuation.

^{4. 21} kw installed.

 ³⁻ton capacity; COP 2.7 to 1; 5.15 kw input; 14 kw supplementary resistance heating; air to air.

^{6. 125,000} Btu input.

^{7.} Residence, 1650 sq ft floor area; large glass crea; 72,000 Blu heat loss; 70F design temp, diff.; 5500 degree days.



RECEPTION area at front of new shop is completely faced by glass wall on street side; contains counter backed by attractive parts-display boards. Aisles open directly into stock' area. Wide glass doors at left (not in view) permit access to modern office space.

Shop Layout Designed for Growth

Philadelphia motor shop combines modern repair methods and equipment with progressive business practices, comprehensive inventory and practical departmental arrangements that provide for flexibility and future expansion.

THIS year, the Penn Electric Motor Company of Philadelphia celebrates its 20th anniversary with the dedication of a new shop. Of concrete construction with an enclosed trucking dock, fireproof wing for strip-dip-bake operations,

modern office facilities, hefty cranes and up-to-the-minute provisions for motor repair, storage and display, the shop takes its place among the country's finest.

With considerable experience augmented by practical analysis of

motor repair problems, partners Previty (Joe and Jim) and Pisano (Fred) have here combined a wealth of good ideas related to the smooth flow of work through their plant, the convenience and comfort of employees and customers alike,



STREAMLINED shop arrangement promotes smooth flow of work from cleaning tank, air-dry booth and tear-down bench (at rear) to final test stand (in foreground). Motors awaiting assembly or testing are automatically transferred by conveyors (at sides and center).



WINDING department and other related "clean" operations are concentrated in bright and coal second-floor work area. Enclosed dumb-waiter expedites movement of motors to and from stripping, dip-bake, assembly and all other departments located on floor below.

plus a high order of flexibility for future expansion or rearrangement of equipment. Safety, orderliness and cleanliness have been repeatedly stressed, while efficiency has been furthered with sensible floor layouts, modern tools and equipment, progressive business procedures and practical inventory methods.

Since approximately 80% of all motors handled in this shop are single-phase fractionals of fairly standardized types, many repair procedures advantageously follow production-line approaches. Therefore individual employees have been trained and have become proficient in specific operations such as disassembly, testing, stripping, spray painting and the like. Winding of fields also incorporates mass-production methods, for fields are grouped into a single operation, with leads and sleeves attached prior to coil insertion into stator slots. Accurate overall dimensions of coils are obtained by using forms and an arbor press that compacts and unifies the end products, this compression method eliminating the necessity for extensive typing or taping.

Another mass-production method involves the use of a shop-designed winding machine that counts coil turns, then automatically stops when the predetermined number has been reached. This insures accurate compliance with manufacturers' data, guarantees original operational characteristics of the motors and also minimizes wire splicing.

On the theory that dissimilar op-

erations require differing skills, materials, equipment and methods, and should therefore be physically segregated from each other, separate departments have been set up to handle repulsion-start inductionrun motors, capacitor and splitphase units, special and emergency motor repairs. For the same reason, the winding department is physically divorced from areas devoted just to assembly, storage, stripping, cleaning, baking, painting. "Clean' and "dirty" operations are likewise confined to different shop sections or floor levels, this whole procedure resulting in the grouping of bake ovens, furnaces, solvent and varnish tanks, paint booths and the like on the first floor (mainly in a fireproofed extension), with an enclosed dumbwaiter shaft connecting these operations with the upstairs winding department.

All of these various sections and departments are located in logical sequence so that, without backtracking, motors can be received, repaired and prepared for pick-up or delivery in an orderly progression of operations. Following a typical motor through the shop would therefore find it being logged in, disassembled, solvent cleaned, air dried, placed in a tote pan and delivered to a general service and stock center where (if needed) new parts would be added, burnt armature fields would be replaced, commutators would be refaced on a lathe, and bearings would be installed and machine reamed. Rewound spare components would also be substituted at this point, while units requiring new coils would be detoured for rewinding, replacement in stock and subsequent reuse in this constant rotational procedure.

This general practice of rotating wound components greatly lessens the overall repair cycle for each motor. However, if windings are special or if an owner prefers to have all of his own components repaired and replaced in his original assembly, his motor will then be treated as a special unit and will be temporarily shelved while rewinding is accomplished.

After all reuseable and replacecomponents have been readied, tote pans are then separated by classification (capacitor and split phase, repulsion-induction, etc.) and delivered by means of inclined roller conveyors to assembly benches. After assembly, motors (together with all discarded parts) are again roller-conveyed to a dynamometer test center, then cart-carried to the painting department where they are spray primed and finished, dried and placed in the "on deck" department for prompt delivery or pick-up.

As noted in this brief runthrough, conveyors and carts are used wherever possible to minimize manual handling of motors and to reduce physical effort of employees. The use of the dumb-waiter, overhead cranes and monorails also serves this same purpose, while local work areas and assembly benches are equipped with conveniently reached tool racks and supply shelves to facilitate shop operations still further.

Provision for expansion in later



ATTRACTIVE all-purpose room adjacent to office features comment-provoking electric kitchenette, lighting fixtures, furniture, drapes, paneled walls and large mural that depicts many of the service operations regularly practiced by this progressive motor-repair shop.



ELECTRIC nut-spinner is one of many modern tools used by this service organization to lessen physical effort and expeditor recurrent shop routines.

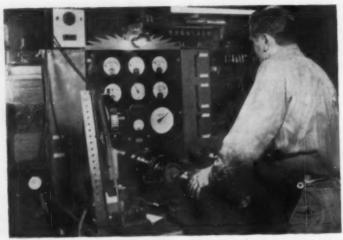
years is obtained by allowing liberal clearances around all benches, at the ends of assembly and conveyor lines, adjacent to storage bins and racks, and alongside all pieces of free-standing equipment. By reducing these clearances as necessity later dictates, extra benches, equipment and storage facilities can be added without disrupting the present efficient routing arrangement.

In this new shop, cleanliness and orderliness are of an unusually high order, reflecting the partners' belief that these attributes have a direct bearing on overall efficiency and morale. In line with this policy, all normal shop operations are halted each day 15 minutes before the official "closing" time, thereby permitting employees (on the company's time) to clean up their various areas of responsibility, replace tools and equipment in designated racks and bins, remove dirt and debris from the premises daily, and to promptly note and report any deficiencies existing in operating equipment or inventory.

This general procedure can likewise be considered to have promotional "plus" values, for numerous customers visiting the shop to leave or pick up motors have commented on the neat, clean, efficient, businesslike appearance of the shop. They have also remarked about the friendly, courteous attitude of Penn Electric employees who serve them. All of these outward signs of care and consideration imply that the organization takes pride in good workmanship and that it directs its attention to details. This in turn promotes public confidence; a confidence which has been tangibly evidenced by a steady 8-year business boom amounting (including motors of all sizes and types) to a gratifying 12% volume increase each year (from 14- to 19-thousand units since 1948).

Another unique promotional idea used successfully by Penn is that of explaining to their customers the importance of (and the exact step-by-step recommended procedures for obtaining) proper motor maintenance.

Records kept on specific motors and of specific industrial customers prove that this educational approach has lengthened the intervals between motor shutdowns and service calls. Contrary to normal assumption, however, this lengthening of intervals has not reduced



TESTING of each repaired motor verifies performance of unit under full range of loading conditions. Loads are simulated through use of prony brake and tension belt, while throw-out point is ascertained by means of tachometer.



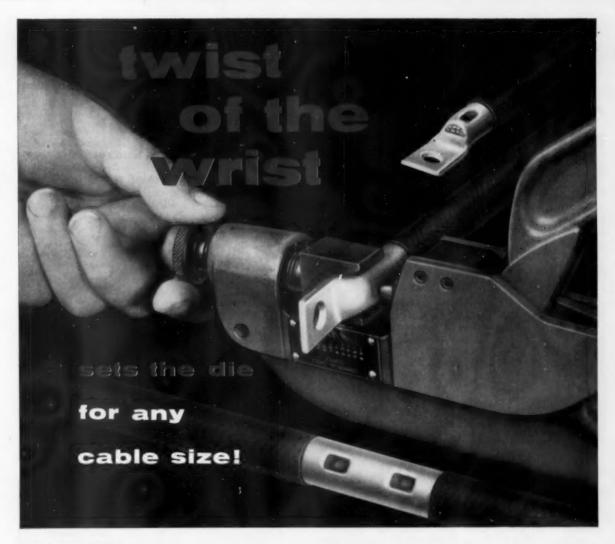
PAINTING of assembled motors is final operation in repair cycle. Spray gun and turntable inside paint booth speed and simplify this routine, while vaporproof lighting and exhaust system combine to promote safety.

the company's overall business volume. In fact, by eliminating calls for minor adjustments, routine cleaning, small parts replacement and such, Penn has largely freed itself from "nuisance" work, "headache" repairs and the necessity for explaining, apologizing for, or reducing legitimate bills rendered for these minor (and generally unprofitable) repairs.

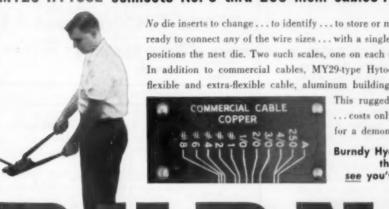
In addition, by clearly demonstrating that their customers' welfare is considered, Penn has profited through related sales of lubricants, brushes, belts, small parts and motors, as well as through increased public confidence plus resulting (and gratis) word-of-mouth customer-to-customer en-

dorsements that are so essential for healthy business growth.

Still other public-relations and promotional methods used by the advertising include through local trade journals and direct mail, personal calls and talks before various civic groups, educational sound movies (showing typical repair operations and techniques practiced by Penn), and teaching electrical courses at night in a local vocational school. All of these approaches serve to familiarize the public with the name, personnel, procedures, reliability and technical "knowhow" of the company, thereby promoting confidence. good will and potential service or sales opportunities.



MY29 HYTOOL connects No. 8 thru 250 Mcm cables . . . without changing dies!



No die inserts to change . . . to identify . . . to store or mislay! A twist of the wrist, and you're ready to connect any of the wire sizes . . . with a single stroke! The cable-size scale (below) positions the nest die. Two such scales, one on each side of the tool, double its versatility. In addition to commercial cables, MY29-type Hytools also install mining, aircraft, and flexible and extra-flexible cable, aluminum building wire, and other special conductors.

> This rugged, lightweight tool is inexpensive, too ... costs only \$36.00. Ask your Burndy distributor for a demonstration.

Burndy Hydent connectors feature the long, deep indent - you can see you've made a good connection!

Norwalk, Connect. . Toronto, Canada . Other Factories: New York, Calif., Toronto . Export: Philips Export Corp.

Data Sheet

Residential Outdoor Wiring

American electrical living today includes recreation and social time spent on patios, porches and terraces during cooler evening hours, creating a demand for lighting facilities—facilities which also serve cooking appliances, radios or power tools. The following are typical electrical construction practices applicable to this rapidly growing market for the electrical contractor.

Capacity

Residential areas planned for outdoor living invariably require capacities in excess of original estimates. Therefore, at least two 20-amp 2-conductor circuits or one 3-wire circuit should be installed, each circuit originating at the panelboard and not as an extension of an existing circuit.

Running Circuit to Outside

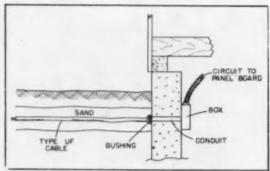
Circuits may be run from basement panelboard directly through the foundation wall or through the wooden sill above the foundation. The former involves more labor, but the installation is not in evidence from the outside.

Circuits from above-grade panelboards in garages, utility rooms, etc., may be run through the building wall from an interior box. After installation of cable, sealing compound should be used around opening to prevent entrance of moisture or insects.

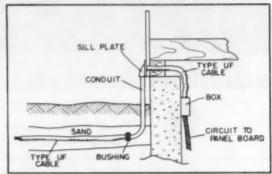
Underground Circuits

Type UF (underground feeder) cable is used extensively for underground circuits, being approved for direct burial without additional protection. Conduit and bushing should be provided as shown to protect cable through masonry and above ground. Enough slack should be left in cable where it enters the building to permit expansion due to temperature changes. Cable should be laid in sand deep enough to avoid damage by spading.

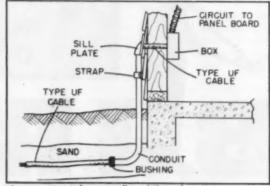
Where there is danger from digging, undue pressure or other abuse, a running board (1 by 2 or larger) should be laid over cable before trench is backfilled. Galvanized rigid steel conduit or equivalent should be used where there is danger from termites or rodents. Any approved moisture-resistant wire may be used where run is entirely within conduit.



Running circuit from panelboard through masonry.



Running circuit from panelboard through sill.

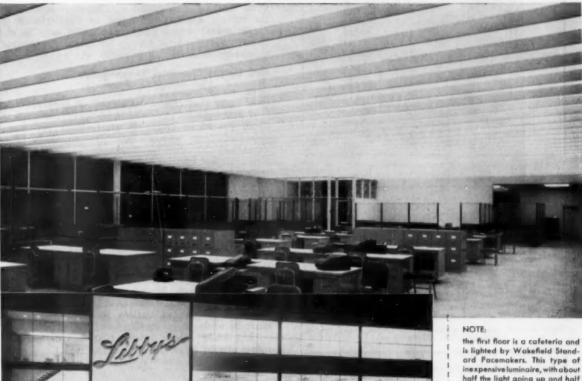


Running circuit from panelboard through wall.

(Continued on page 140)

WAKEFIELD CEILING

Another Installation



75 footcandles everywhere . . . and not a shadow anywhere

For the general office of this new Canadian building, architect J. W. Storey put 75 footcandles of glare-free, shadow-free light on the desk tops by using a Wākon® vinyl ceiling with lamps mounted on 36" centers directly over the acoustical baffles.

The result is a working environment conducive to daylong efficiency and high morale.

Such multi-function ceilings as this one, which covers 6000 square feet, are a Wakefield specialty. A complete package, complete with mechanical and electrical systems, they can be designed to fit any shape or size of interior and are installed in their entirety by an electrical contractor.

For brochures describing and illustrating this and other Wakefield multi-purpose ceilings, write to

THE WAKEFIELD COMPANY

WAKEFIELD LIGHTING LIMITED LONDON, ONTARIO

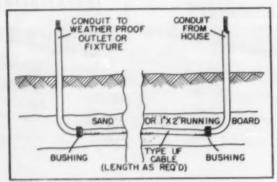
FLECTRICAL CONSTRUCTION AND MAINTENANCE . . . OCTOBER, 1956

inexpensive luminaire, with about half the light going up and half down, makes a room bright and cheerful and lends inviting sparkle to the food.

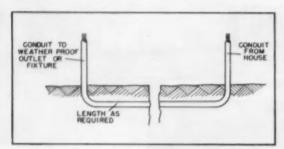
New Libby, McNeil & Libby Building, Chathem, Ontario Architect: J. W. Storey Electrical Contractor: J. V. McDonnell Electrical Construction Company Limited, London, Outsrie

Electrical Consulting Engineer: McGregor, Anderson and Beynon, Toronto, Ontario

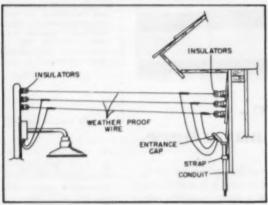




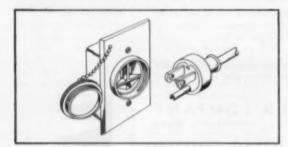
Type UF cable used underground without protection.



Rigid conduit used for protection of underground circuit.



Overhead wiring used for outdoor lighting.



Grounding-type weatherproof outlet and plug.

Overhead Circuits

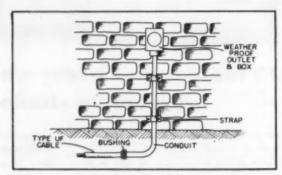
Open wiring run overhead is often more economical for certain applications (such as floodlighting of sports areas) where proper clearances may be obtained. Service drop, service entrance or approved weatherproof wire may be used.

NEC Height Clearance Requirements

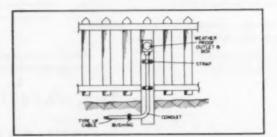
Over roofs Over roofs that cannot be walked on because		ft
of steep pitch	3	ft
reached	10	ft
etc. Point of attachment on building—minimum	3	ft
distance above ground		ft
Over driveways (desirable)		
Over driveways (minimum)	12	ft
Over walks		

Convenience Outlets

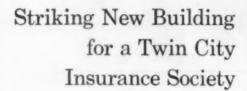
Outdoor outlets located for plugging in garden lights, power equipment or appliances should be of the weatherproof type. Flush-mounted outlets in roofed-over areas may be installed in standard outlet boxes, but surface-mounted outlets in exposed locations must be enclosed in weatherproof outlet boxes. All outlets except those intended solely for portable lights should be of the grounding type.



Weatherproof outlet and box surface-mounted on masonry.



Weatherproof outlet and box surface-mounted on fence post.





Latest addition to the growing Minneapolis, Minn., business center is the beautiful new home office of the Lutheran Brotherhood, a fraternal life insurance society. This modern building boasts a number of unusual features, including a unique sunken garden and terrace, exterior walls of blue-green porcelain-enamel steel and 640 windows of double-pane plate glass.

One of the requirements for this building was an electrical system of the highest quality. That's why Phelps Dodge building wire and paper insulated power cable were installed exclusively.

On every wiring job where top-quality materials, expert workmanship and experienced "know-how" are called for, it pays to rely on Phelps Dodge and your Phelps Dodge distributor!



PHELPS DODGE COPPER PRODUCTS

SALES OFFICES: Atlanta, Birmingham, Ala., Boston, Buffolo, Charlotte, Chicago, Cincinnati, Cleveland, Dallas, Detroit, Fort Wayne, Greensboro, N. C., Mouston, Jacksonville, Kansas City, Mo., Los Angeles, Milwaukee, Minneapolis, New Orteans, New York, Philadelphia, Pittsburgh, Partiand, Ore. Richmond, Rochester, N. Y., San Francisco, St. Louis, Seattle, Washington, D. C.

Fixtures

Play area lights, porch and entrance lights, eave floods, and post and driveway lights should be wired permanently without plug and outlet provisions where practical. Small garden lights, however, are moved frequently to most advantageously set off plants, shrubs and trees and are more easily accommodated through outlets. Similarly, special underwater fixtures for garden pools may be removed and stored during winter months.

Switching

Outdoor circuits are most effectively controlled from indoors, although weatherproof switches are available for outdoor mounting at specific play areas, etc. Lights or convenience outlets used for a common purpose (garden lights, recreation area lights, etc.) should be switched as a group. For more flexible multi-point control, a low-voltage remote-control system may be readily adapted.

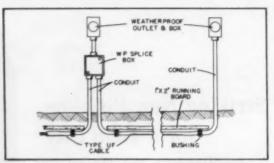
Recommended Wire Sizes for Outdoor Circuits

(2-conductor 120v or 3-conductor 120/240v)

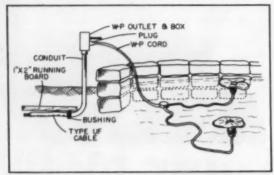
May leavily (6)	Wire Size (AWG)				
Max length (ft)	15-a fusing	20-a fusing			
50	14	12			
100	12	12			
150	12	12			
200	12	10			
250	10	10			

Maximum Number of Lamps per Circuit

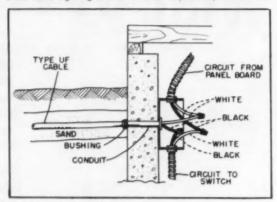
Lamp Watts	15-a circuit	20-a circuit
200	8	10
150	10	14
100	16	20
75	21	27
60	32	40



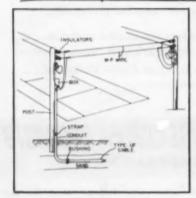
Conduit to weatherproof outlet and box used as support,



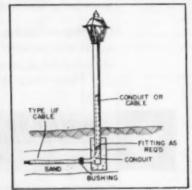
Underwater lighting unit connected to weatherproof outlet.



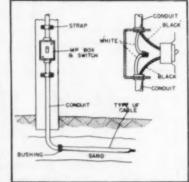
Switch control of outdoor circuit



Floodlight fixture for sports area.



Ornamental post lighting fixture. Wee Courtesy General Electric Co., Construction Materials Division



Weatherproof switch located outdoors.

CUT DOWN INSTALLATION

TIME with



BLACKBURN
TWO-BOLT CLAMPS

One piece construction simplifies installation—eliminates assembly problems—no falling parts—no missing pieces—no special tools necessary. Available in copper or heavily tools necessary and tools necessary. Available in copper or heavily tools necessary.

Long bolt is peened, capturing spacer and top casting.
Spacer is ringed and swings easily over conductor. Free
bolt is held in place by neoprene washer during installation.
Contoured spacer keeps conductor in original shape and
stributes unit pressure over large area of conductor,
distributes unit pressure over large area of conductor,
minimizing cold flow and provides wide separation between
the aluminum and copper conductor, reducing possibility

of galvanic corrosion.

Shakeproof washers prevent loosening under the most severe operating conditions. Washers, castings, bolts and spacers are of copper alloy, completely tin plated.

Write today for complete specifications and prices on Blockburn Two-Bolt Clamps.

JASPER

BLACKBURN

PHONE: MAIN 1-2

ELECTRICAL CONSTRUCTION AND MAINTENANCE . . . OCTOBER, 1956



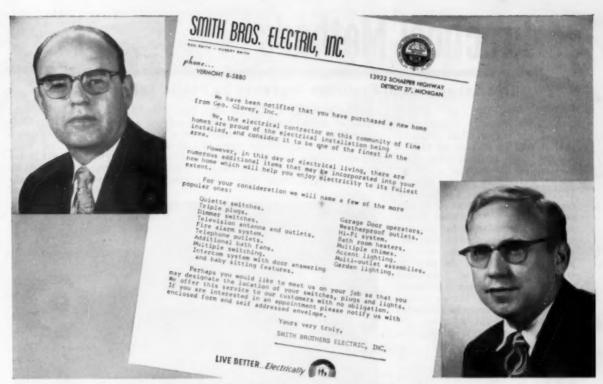
Hubert Smith, George H. Glover and W. Huller, Builder Coordinator for the Detroit Edison Company, at the site of an All Electric Home. Close working arrangement among the electrical contractor, builder and local utility is the key to the success of

the project. Live Better... Electrically offers a perfect opportunity for these trade allies to promote the many wonderful benefits of electrical living today. The Smith Brothers are an excellent example of contractor participation in this program.

Smith Bros. Electric, Inc. steps up high-quality LIVE BETTER...

Here is an outstanding example of how one electrical contractor is capitalizing on the great interest of Live Better... *Electrically*. Smith Bros. Electric, Inc., of Detroit, Michigan, uses the Live Better... *Electrically* theme to promote high-quality business, emphasizing complete modern installations as a supplement to standard wiring.

George Smith, one of the founders of National Electric Week, became interested in the possibilities of Live Better ... Electrically at the closed-circuit telecast sponsored by the Detroit Edison Company. The Smith Brothers immediately developed a close working arrangement with George Glover, prominent Detroit builder. The announced sales price of a home includes a basic wiring and fixture allowance. Smith Brothers send a solicitation letter to new buyers, follow



Promotional letter sent to new home owners by Smith Brothers Electric stresses the electrical "extras" that are essential to better electrical living. This phrase is key to contractor profits and helps "sell up" wiring job. George and Hubert Smith emphasize the necessity of creative thinking and selling for electrical contractors and of working closely with the utility and builders. Active promotion has boosted this part of the business to one-third of the total volume,

business with the power of

Electrically



up with a mailing of the Live Better... Electrically book "New Step-by-Step Ideas," and then arrange a "no-obligation" appointment. The electrical "extras" sold to the buyer then become part of the cost of the house, the added amount being paid to the builder before the deal is "closed."

"We believe there is a great future in the residential field," say the Smith Brothers, "and Live Better... Electrically is going to make that future even greater."

A new 64-page book, "How to Help Home Owners" (LBE-5), has been produced to help you help your clients live better electrically. In digest size, this book contains complete plans for "load-matched" residential systems . . . a new and realistic approach to a steadily growing problem. Ask your local electric utility for this book.

LET THESE 2 POWERFUL CAMPAIGNS WORK FOR YOU

HOUSEPOWER

programs are working together to boost contractor business. These two powerful campaigns are tied in closely with the activities of the National Electrical Contractors Association and the National Association of Electrical Distributors.

Practical Methods

High School Social Facilities Improved by Public Subscription

MODERNIZATION

A survey recently conducted in one of our major cities indicated that it cost an average of \$1.50 a day per pupil to finance its school system. On the basis of a 180-day school year, that figure becomes \$27,000 annually, per hundred students. The survey went on to allo-cate this amount between books, maintenance, salaries for instructors, etc., and it showed that less than half a cent per day was ex-pended for lighting. In this instance, lighting was considered "adequate" by generally-existent standards, yet the survey proved that the lighting could be up-graded materially without affecting the overall operating budget by more

In many localities this up-grading is being put into effect as a justified increase, for analysis has indicated that modern learning depends greatly upon visual perception, and research has proved conclusively that seeing and comprehension can be speeded up by the provision of more light of the proper quality. Furthermore, since schools are now being used by more students (via double day sessions, plus adult education and evening classes) as well as for more civic activities (PTA meetings, community gatherings, rental of stage facilities to local dramatic groups, or gymnasium facilities for private dances), the cost for improving many features of a school building can be spread over many more people or functions. It is also possible to underwrite the expense of more attractive surroundings by popular subscription, as was done in Lakewood, Ohio; a suburb of Cleveland.

In this instance the promotional campaign was conducted through the local PTA and, by raising additional money in this manner from residents in the community, it became possible for the Board of Education to approve more elaborate plans for their high school than would have been expedient otherwise.

One of the additional rooms paid for entirely by this PTA-sponsored community subscription is a social center. Used by both student and civic groups, it is attractively furnished, vinyl-tiled on the floor and acoustically-tiled on the ceiling. Walls of rough brick present an interesting textured effect, emphasized by downlight, from recessed pinpoint spots located beneath grilled air-conditioning ductwork, and by uplight, from ornamental

portable floodlamps placed along walls on a variety of tables. General lighting is provided by large circular ceiling coffers indirectly illuminated by silvered-bowl lamps surrounded by frosted-glass annular panels, while wide-dispersion speak-



SOCIAL ROOM, paid for by PTA-sponsored community financing program, is comfortably furnished, plainly yet effectively decorated, lighted by recessed silver-bowl coffers plus up-turned spotlamps along rough-brick walls, equipped with air conditioning louvers and semi-recessed speakers for music or public announcements.



SNACK BAR at one side of social room is lighted by valance treatment that directs light upward to upper wall and ceiling as well as downward to counter top. Mural of Great Lakes industrial activities is highlighted by series of lensed downlights which are recessed into the acoustical tiled ceiling.

Simplify your raintight installations

with INTERCHANGEABLE **Qwik Align* HUBS**

Here for the first time is an interchangeable hub arrangement that can be moved to align with the incoming conduit or conduit opening of the device mounted immediately above. Qwik Align Hubs provide a choice of conduit openings from %" through 2" on all raintight enclosures for Stab-lok circuit breakers and Federal Pacific fusible service equipment, and safety switches. Any size hub opening can be used with any of the above enclosures through 200 ampere capacity.

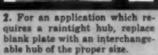


- Do away with "dog legging" conduit.
- Speed raintight installation.
- Save cost of nipple offset.
- Eliminate hub-size problems.
- Underwriters' Laboratories, Inc. approved.

Qwik Align Interchangeable Hubs are available in 5 sizes from %" through 2".



1. Standard "RH" raintight en- 2. For an application which reclosure for application where no raintight hub is required.



3. Elongation in hub plate slots permit adjustment to conduit position. Plate can be reversed for forward hub location.

Finest Products Engineered

FEDERAL PACIFIC ELECTRIC

50 Paris Street . Newark 1, N. J.





NOW...your Federal Pacific OVER-THE-COUNTER

FEDERAL PACIFIC

Now a simple "over-the-counter" transaction solves virtually all your panelboard needs. Even complex panelboard orders can be filled INSTANTLY... RIGHT OUT OF DISTRIBUTOR'S STOCKS! And it's all made possible because Federal Pacific took the universally accepted Type AB Circuit Breakers... added stabs... and gave them "plug-in" flexibility.

The unique combination of STABREAKER flexibility and prefabricated STABREAKER panel enclosures provides the fastest method of obtaining the most flexible system of lighting and power distribution panelboards ever devised! Results: no more waiting for factory-assembled panelboards...simplified installation...big savings in time and money.



REVOLUTIONARY NEW BREAKER SLASHES SPACE AND COSTS!

It's a big 2 for 1 story for panelboard lighting circuits... the new single-pole "NE-S" frame STABREAKER! Gives twice the number of lighting circuits in the same space occupied by conventional single pole breakers. Only ½6" wide! Half the former width...less than half the former cost...without sacrifice of AB circuit breaker quality.

Finest Products Engineered

Distributor offers you PANELBOARD SERVICE with

STABREAKER

HOW STABREAKER "OVER-THE-COUNTER" PANELBOARD SERVICE SAVES YOU TIME AND MONEY



1. Four different size panel assemblies are available (single and double bussing) to accommodate "NE-S", "NJ-S" frame stabreak Main capacities are up to 600 amps. The branch circuits required determine the size panel assembly you need.



2. Then "plug-in" the combination of ratings and frame sizes of STABREAK-ERS required. All standard ampereratings through 225 amperes available.



3. When space for spare branches is needed, complete dead front is secured by means of filler plates included with each panel assembly. Merely break off required section of filler strip and slide into place. Trim holds breakers and filler strip firmly.







STABREAKERS for AB-I Enclosures, too!

The same plug-in STABREAKERS used in STABREAKER Panelboards can be used for individually enclosed circuit breakers, too. With STABREAKER you simply "plug-in" all ratings from 15 through 225 amperes in only two NEMA-1A STAB-Inclosures. Results: unmatched flexibility and convenience... simple interchange of ratings... visible disconnect... simplified installation.

FEDERAL PACIFIC ELECTRIC COMPANY

Main Office: 50 Paris Street, Newark, N. J.



PEDERAL PACIFIC ELECTRIC

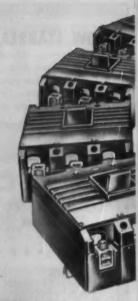
for unmatched AB-I

FEDERAL PACIFIC

By simply adding "stabs" to Type AB molded case circuit breakers, Federal Pacific has created STABREAKER—the greatest single advance in industrial circuit breaker design in years!

Now you can plug-in any rating from 15 to 225 amperes in only two NEMA 1-A STAB-INCLOSURES! One STAB-INCLOSURE accommodates the "NE-S" and "NF-S", and the other the "NJ-S" Circuit Breakers! Two more enclosures of the bolted type, round out the complete NEMA 1-A AB-I enclosed circuit breaker line. One for the NK, and NKL. The other for the NL.

With plug-in type STABREAKERS and only two enclosures you benefit from undreamed of flexibility, convenience and savings in maintenance! Just look at some of the advantages you receive:



*Direct from your Federal Pacific Distributors' stocks!



INDIVIDUALLY PACK-AGED STABREAKERS AND NEMA 1-A STAB-INCLOSURES. For your convenience, are separately packed...can be stored safely until ready for use.



PLUG-IN INSTALLATION. The simplest installation possible. No blind fishing for hidden screw holes because breaker automatically aligns itself when "plugged-in". Bolts through breaker front provide extra holding power. And you've got an entire boxful of space for line side wiring.



SIMPLE INTERCHANGING OF RATINGS. Nothing is easier than accommodating changes in amperage ratings. Simply pull out STABREAKER to be replaced...disconnect load side wiring. Then plug-in the new STABREAKER, reconnect load wires and it's done! No need ever to touch line leads if you have conductors of ample capacity.

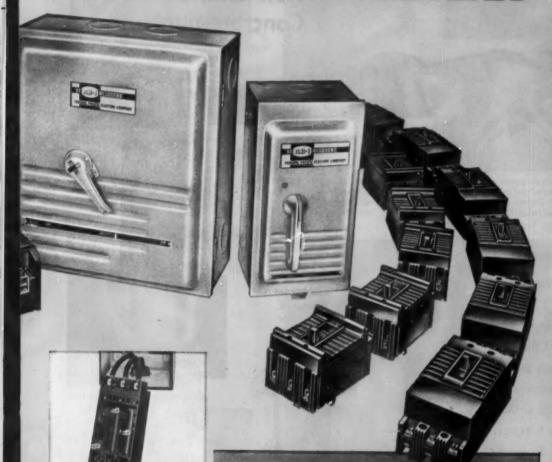
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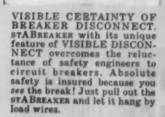
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STABREAKER*





ELECTRIC

STABREAKER FOR PANELBOARDS TOO!

The same plug-in STA BREAKERS are also the answer to your panelboard problems. With four basic enclosures and a complete range of STABREAKERS up to 225 amp. including the 11/16" single-pole STABREAKER, you can now get instant over-thecounter delivery of lighting and power distribution panelboards! You save delivery time! You save money! You save installation time!





BM

INDENTER TYPE FITTINGS

FOR E.M.T.
Concrete-tight

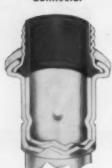
Briegel, the Original Indenter Fittings are neater in appearance, easier and faster to use. Installation is simple and less expensive.

Two quick squeezes sets them forever.

Try B-M Indenter Fittings and get more profits from each job.



Red Throat Insulated Connector



Red Throat Cross section



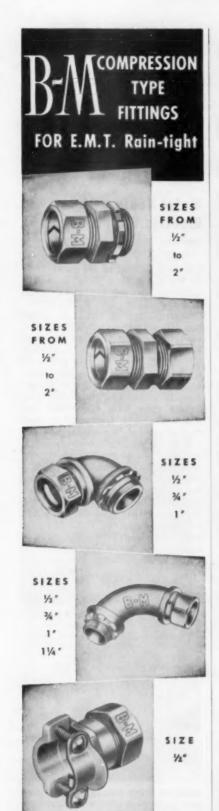
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Warehouse Stocks in Principal Cities for Immediate Delivery!



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ENTRANCE FOYER is also lighted by silver-bowl lamps in circular ceiling coffers, while trophy cases (not lighted when this photograph was taken) may be separately illuminated by shielded fluorescent lamps placed behind upper lips of these display areas. Metal railings at stairs and comfortable lounging benches add interest.



GYMNASIUM in Lakewood High School is evenly illuminated to intensity of 50 footcandles by means of 2-lamp louvered industrial fluorescent fixtures mounted 22 ft above the floor in rows placed on 10-ft centers. Gym is used for civic as well as for student functions, thereby extending the utilization of this educational center.

ers are semi-recessed into the acoustical ceiling to provide music for social functions, or to permit public announcements.

This social center is also equipped with a snack bar, soda fountain, and bas-relief mural of Great Lakes industries. These focal areas are illuminated by a variety of valances and coves, lensed downlights and recessed spots, with upward components of light illuminating the

upper wall and ceiling immediately above the service counter.

Rough brick walls, acoustical ceiling tiling, silver-bowl circular coffers and semi-recessed loud-speakers are also combined in the decorative scheme of the adjacent entrance foyer. The flooring, however, is terrazzo, while the paneled wall facing the lobby steps is fitted with trophy cases which are separately illuminated from above by



Stronger, better insulated and easier to use, IDEAL Crimp Connectors give you perfect, pre-fabricated insulation all around the joint and between the wires, with a puncture-proof cap and double thickness over the wire ends, plus a deep skirt that completely covers the bare conductor even when wires are not stripped evenly.

Parfect Connections in 3 Quick Steps





mp Push "Wraprve with Cap" down tween wires a AL Elseaver sleeve. and of joint.

NO EXTRA TOOL NEEDED I

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*Patented, No. RE23649 and other patents pending.

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ELECTRICIANS PLIERS

Crimp the Sleeve, Twist the Wire Burr the Conduit

A tool so good you'd want it even without the IDEAL Crimp Connector! Built for all around electrical use. Plastic covering on handles give comfortable grip.

SOLD THROUGH AMERICA'S LEADING DISTRIBUTORS In Canada: Irving Smith, Ltd., Montreal

IDEAL

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Please send catalog date on the new IDEAL Crimp Connector, "Wrep-Cep" Insulator and Electricians Pilers.

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shielded fluorescent striplights.

Another area in the Lakewood High School which is used for civic as well as student activities is the gymnasium. Here the average intensity at floor level is 50 footcandles, provided by rows of louvered 2-lamp industrial fluorescent fixtures mounted 22 ft above the floor with rows spaced on 10-ft centers. These fixtures, as well as air conditioning ducts and vents, are mounted slightly above lower chords of roof-trusses.

Motel Heats with Electric Wall Units

HEATING

Built-in electric wall heaters are used to heat all 60 guest units of the Betsy Ross Motel in North Carolina, located five miles south of Fayetteville on U.S. Route 301. Completed late in 1955, the Motel has already experienced the use of electric heating through its first heating season and its manager, Samuel F. King, reports first cost was low, operating costs were economical, the system is exceptionally clean, and the owner and guests alike have been most enthusiastic over the comfort and convenience of the system.

Each guest unit consists of a spacious room with tub-shower combination, and is heated with a 3000-watt, 240-volt Markel automatic Fan-Glo Heetaire unit, Model H237KT2, recessed in the wall of the bedroom. It produces two kinds of heat—infra-red radiation and fan-forced heated air. The double-action unit, which has a built-in thermostat, contains two Neo-Glo elements. One is mounted in front



BUILT-IN WALL HEATERS are used to heat the 60 guest units of the Betsy Ross Motel, near Fayetteville, N. C. economically, efficiently, and automatically. Heaters are 3000-watt 240-volt Markel automatic Fan-Glo Heetaire units. of a polished reflector to provide the radiant heat. The other element heats the cold air which the fan draws in at the base of the unit.

Mr. King attributes the low operating cost of the system to the automatic feature of the units, in that they turn on and off automatically to maintain the zone of comfort selected. This feature has also appealed to guests, Mr. King reports, because each unit can be regulated for its own degree of heating to suit individual occupants whenever desired, and the electrical heat is instant, safe, and fumeless.

The owner estimates that there was a tremendous saving in the initial cost of the installation as compared with older methods of heating, because there was no major construction necessary and no separate space required for oil burners or boiler rooms. There has been no service cost whatsoever. the walls and ceilings have not been damaged by dirt and fumes, and the usual major yearly outlay for cleaning and maintenance has been eliminated. And in addition, the operating cost has been held down by effective insulation.



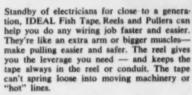
FRAMING MEMBERS for storage bins or racks can be easily and quickly constructed by using pre-slotted and perforated angles. Bottoms of bins may be formed from plywood panels of any desired thickness, while partitions between adjacent bins may be formed either from short sections of the angles or from sections of wooden boards. As indicated, angles are fastened together by means of hex-head bolts and nuts, while the wooden partitions are attached to angles by screws inserted through pre-punched holes in the angle side members. These shelves, as here used by the electrical maintenance department of the Star Market chain in Cambridge, Mass., are easily erected and, if later desired, are completely salvagable for re-use in another location or storage area. Since angles are precision formed and accurately marked, assembly requires the use of only a hack saw and wrench.



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FISH TAPE, REEL and PULLER



You reel in and pull the tape through conduit in one easy operation . . . no skinned fingers—no cuts—and no lost time! The tape never gets snarled.

Saves work—saves time—saves money! The IDEAL Fish Tape Reel and Puller costs so little you can't afford to be without it! 50 to 200 foot lengths—all tapes are of finest grade, oil tempered flat spring steel.

Now Step Up the Performance of Your IDEAL Fish Tape, Reel and Puller with the

NEW (DEAL) FISH TAPE WINDER

Makes IDEAL Fish Tape Real Even More Useful

Reduces still further the work of fish tape pulling when used with an IDEAL Fish Tape Reel. As Winder is nulled around Reel it spreads the Reel housag so that the tape can be reeled in or out with least effort. Double rollers hold Winder in piace as handle is rotated. Three sizes for all IDEAL Reels.

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Ask these questions, too, when you judge a fluorescent lamp...



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Check Westinghouse Fluorescent Lamps against any other brands you are now using. Check them for maintained brightness, long life, uniform appearance. If you are not entirely satisfied on all counts, your full purchase price will be refunded.



Is it the correct type, size and color for the lighting job to be done?

In the Westinghouse fluorescent family of 290 different lamps—including Slimline and Rapid Start—there's a type and size precisely right for every office, plant and store application. Colors include seven different shades of "white" alone.



How about quality control?

From raw materials to finished product, every Westinghouse fluorescent lamp is subjected to 480 inspections and lests before approval for shipment.



For the full story on how to get more for your money in fluorescent light, contact your Westinghouse Lamp Representative.

WATCH WESTINGHOUSE

WHERE BIG THINGS

ARE HAPPENING FOR YOU!

Baffles Shield Light And Absorb Sound

LIGHTING

This classroom in the Riverview Elementary School of St. Paul, Minn., measures 28-by-30 ft, has a 10-ft ceiling height and combines grey and natural wood walls with a flat white ceiling and mottled beige tiled floor pattern.

Illumination at desk level is as high as 77 footcandles at the front of the room, although the average is 35. This boost of light in the instruction and demonstration area of the room is due to the fact that six fluorescent lamps are operated at 430-ma, whereas the remaining 24 lamps are operated at 200-ma. All amps are 8-ft T-12s, mounted 3-per-

row with a 29-in. row-to-row spacing interval.

Construction and installation of structural components is basically simple, with bare steel beams painted to blend with the ceiling and acoustical baffles suspended from the ceiling slab at right angles to these beams. Wiring channels parallel the beams, with lamps installed from channel to channel, parallel with the suspended baffles.

The result is good illumination with a high order of shielding and absorption of sound; a combination promoting maximum visibility and minimum distraction for young students in this center of learning.



DUAL AMPERAGE levels for lamp operation result in creation of higher-level illumination over instruction area than in remainder of classroom. Lamps are installed at right angles to their respective wiring channels and parallel to suspended baffles that serve double purpose as shields against direct glare plus sound-absorbing mediums for extraneous noise.

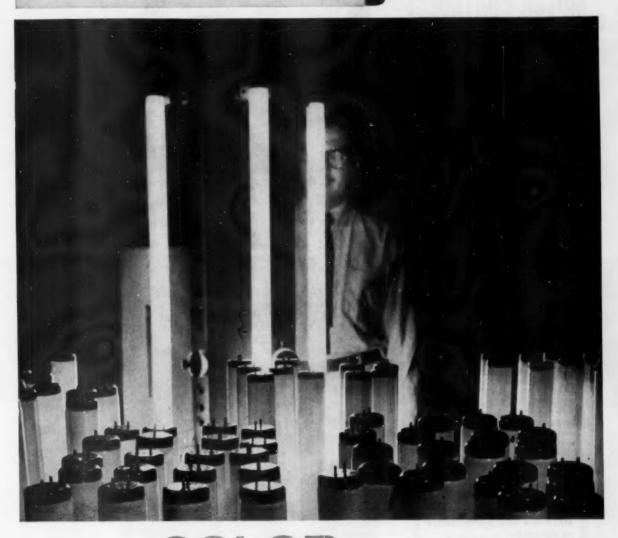
Certified Lighting Brightens Gift Shop

LIGHTING

Certified Lighting has been used by Stone's Gift Shop, La Mesa, Calif., to provide a bright and attractive atmosphere in their newly remodeled 1500 sq ft sales area, with an intensity of 79 footcandles.

This area was formerly occupied by a hardware store. It was remodeled, and adapted to the requirements of the new gift shop. The store is 24 ft wide by 62 ft long, with a ceiling height of 12 ft 6 in. A column-supported beam, which also conceals various piping, runs down the center of the store from front to rear. The shop had the ceiling finished off-white, the walls light tan and green, and the floor light tan.

A lighting system was planned which will encourage passers-by to stop, and give them a pleasant and attractive place in which to shop. The center beam was altered to accommodate ten 96T12 single strip slimline lamps in a cove which provides a diffuse indirect lighting effect on the white ceiling. In addition, eleven 8-ft All-Brite "Area Liter" units, each equipped with four 96T12 fluorescent white lamps are surface installed on the ceiling normal to the beam and side walls, with ten hood type 150-watt swivel units interspersed one to each space between the fluorescent units. The fluorescent units provide a high level of diffused lighting throughout the store, and the incandescent how to judge a fluorescent lamp ... point no.



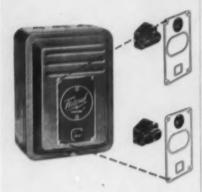
ask about COLOR MATCH

You can be sure that the Westinghouse fluorescent lamp you buy today will exactly match the Westinghouse lamp of the same color classification you bought yesterday or years ago. Two facts guarantee it. First, to insure strictest uniformity, Westinghouse makes all of its own lamp phosphors, the tube-coating materials that determine lamp color. Second, Westinghouse (and only Westinghouse) uses "drift-free," Halo-type Phosphors throughout its entire fluorescent lamp line.

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FEDERAL PACIFIC adds <u>new</u> flexibility to **MOTOR CONTROLS!**



Three-way application with this single unit!

Convenient...simple...time conserving...the new Federal Pacific Motor Starter Conversion Kit literally permits triple duty performance from NEMA I enclosures size 0 through 3—allows each to perform as either remote control (Form I), local control (Form II) or selector switch (Form III) motor starters!

SIMPLIFY INVENTORY—simply stock the basic starter plus Form II and Form III conversion kits and you can meet motor starter requirements up to NEMA size 3.

QUICK SIMPLE CONVERSION — no necessity to punch out or knock out holes to facilitate conversion. The facilities are designed into the unit.

COLOR CODED WIRING – color coding eliminates confusion...makes wiring a quick, simple operation.



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COMPANY 50 Paris Street, Newark 1, N. J.



A COMBINATION of lighting from coves, fluorescent luminaires, and incandescent swivel spots create a bright and attractive interior for shopping at Stone's Gift Shop, La Mesa, Calif. Intensity averages 79 fc throughout.

swivel units are used to highlight special counter or wall displays.

The total power consumed by this lighting installation is 6900 watts, or 4.6 watts per square foot of interior lighting. With an initial lighting intensity of 79 footcandles (after 30 days' service), the overall efficiency of the entire lighting system was 17.3 footcandles per watt per square foot, with 5400 watts of fluorescent and 1500 watts

of incandescent lighting.

Sun Electric Co., of La Mesa, were the electrical contractors for this job, which was certified as meeting the requirements of the NEMA Certified Lighting program. R. J. Huff, Commercial Lighting Department of the San Diego Gas & Electric Company, prepared the lighting design in cooperation with the electrical contractor and the owner.



GOOD LIGHTING is practiced as well as preached by Rochester, N. Y. architect Michel Dee Angelis, who illuminated his smart office with slimline lamps placed on 2-ft centers across an acoustical tiled ceiling, then shielded the lamps by means of a specially-designed large-cell wooden canopy grid suspended 2-ft below the true ceiling. Partitions between offices, foyer and drafting rooms are composed of structural glass panels in various surface textures, so that lighting in any area serves to back-light the walls of the room adjoining. This treatment, together with the use of modern furniture, colorful upholstery and wall-to-wall carpeting, has served to prove to prospective clients that lighting is an architectural medium which may be used intelligently to enhance otherwise-conventional small areas.

Super Durabake A NEW FINISH FOR S&C METALCLAD SWITCHGEAR

Developed for rigorous outdoor or indoor service, Super Durabake withstands high temperatures, high humidities, blasting effects of wind and sand, and corrosive atmospheres. See below how this tough finish is achieved.

prevents rust, eliminates maintenance wherever installed



All enclosures are fabricated of scale-free, oxide-free, cold-rolled steel sheets, permitting a smooth, blemishless finish found only on top-grade consumer items.



Surfaces to be welded, later inaccessible, receive special preparation which consists of a phosphatizing bath plus an application of metallic zinc.



All welds are ground and sanded to remove the scale formed during welding. All internal welds, seams, joints, and splices are wire brushed.





Metallic zinc in alkyd resin is sprayed on all inside and outside surfaces of the enclosure and all parts which are then baked in a huge oven at 300 degrees F.



A rust-resistant primer (sinc-chromate-iron oxide) is applied by the spray method to all surfaces. This coat is allowed to air-dry thoroughly before processing continues.

The enclosure and all parts are phosphatized. This treatment removes any remaining grease or oil, etches the steel slightly, and forms a neutral, rust-resistant coating.

The finish coat, of melamine and alkyd resins, is hot-sprayed, permitting an unusually thick, homogeneous coating without runs, sags, or blisters. It is equivalent to a four-

coat air-dry finish.

All parts are baked at 300 degrees F producing a hard, dense surface required for long life and smart appearance, impossible to achieve with air-dry finishes. Baking is done in an extra-large oven unique in the switchgear industry.

For added protection against ground moisture, a thick coat of asphalt paint is applied to the enclosure's bottom perimeter. A heavy coat of "Insulmat," a "no-drip" compound, is applied to the inside surface of the roof to prevent condensation.



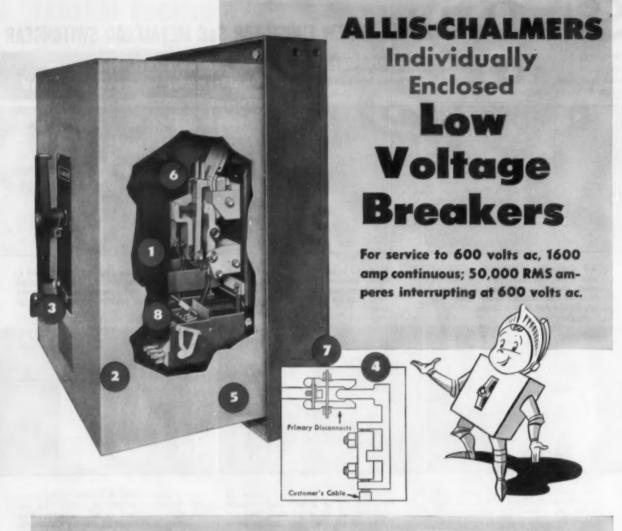




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- 1. Dead front—Even with enclosure cover removed, breaker is entirely safe.
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- 3. More safety Interlock prevents removal of cover while breaker is in closed position.
- 4. Pull-out construction—Easy removal of breaker without disconnection of cables. Access to cable connections through entire front opening.
- 5. Weather-proof or dust-proof as well as standard, general purpose enclosures are available.
- 6. Long life contacts Blow-on type action means high contact pressure - no bounce - less erosion.
- 7. Positive high pressure connection provided by compression springs on primary
- 8. Accurate time-delay control provided by hermetically sealed, positive displacement trip device.

Get More Information - Contact your nearby A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin, for Bulletins 18B8252 and 18B8283.

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Use first line of boxes. Insert item numbers of products on which more information is desired.

CATALOGS, BULLETINS AND ENGINEER-ING DATA:

Use second line of boxes. Insert item numbers of literature desired.

ADVERTISEMENTS:

Use third line of boxes, Insert page numbers of advertisements on which additional information is desired. Where more than one advertisement appears on the page, include the manufacturer's initials.

IMPORTANT...

- PLEASE PRINT-LEGIBLY
- . USE BLACK OR DARK BLUE INK
- O DO NOT USE PENCIL OR RUBBER STAMP

Product News



Protective Gap

A protective gap for series capacitors used with distribution transformers. The gap is designed to prevent extreme voltages appearing across a series capacitor when abnormal current conditions occur, and to reinsert the capacitor into a circuit upon return to normal current conditions. Series capacitors connected in the primary of distribution transformers economically solve the problem of starting moderately large single-phase motors on power systems. 5% impedance series capacitors with the protective gap provide nearly zero transformer regulator and freedom from sustained resonance.

General Electric Co., Schenectady 5, N.Y.



Sound System (2

A single-channel control consolette (MI-14980) for school and industrial sound systems. Unit measures 22 in. wide and can be mounted on a desk. It provides facilities for communicating with up to 16 rooms and incorporates a program or input source for distributing entertainment or educational programs from radio, tape recorder, phonograph records, or the unit's combination monitor-microphone. Provisions are incorporated for the addition of supplementary audio inputs. A self-contained instrument, it features a 10-watt amplifier with a frequency range of 50

to 15,000 cycles; a balanced 70-volt output; low-impedance; and a monitor loudspeaker which serves also as a microphone. A press-to-talk key is utilized for intercommunication operations. Program distribution is controlled by a single 3-position switch, includes an all-call position, to provide automatic cut off of programs for priority announcements. Individual pushbutton switches are incorporated in the consolette for selection of any one or combination of rooms for reception of messages or program materials. It is 9 in. high, 12 in. deep, and 22 in. wide.

Radio Corporation of America, Camden, N. J.



Clock Thermostat (3

A new model electric clock thermostat, restyled to complement interior decorating schemes. It features a gold body and a clear plastic-covered white face. The new day-night control thermostat is still the same size and rectangular shape of the model that has been a household and commercial standard. The mercury thermometers for temperature indication have been replaced with a coiled bi-metal element.

Minneapolis - Honeywell Regulator Co., Minneapolis, Minn.



All 400-watt A-H1 mercury lamps are now available with weather duty hard glass bulbs as standard. With the weather duty bulb, A-H1 lamps are weatherproof and are recommended for heavy duty indoor and outdoor service. They are designed to stand up under such adverse conditions as fluid splatter and in the presence of industrial gases; they are also proof against crazing or cracking in normal service.

Westinghouse Lamp Division, Mac-Arthur Ave., Bloomfield, N. J.



Fixture

A new dual purpose fixture, called the Multi-Vent Trofferlite, diffuses conditioned air and provides illumination. It is adaptable to any drop-typecelling. Where minimum cooling is needed, the fixtures can remain unattached to the air duct or shut down. Available in egg-crate hinged louver, baffle type louver or open Trofferlite. The Directlite, incandescent spotlight may be used between troffer units in continuous runs or at ends of runs, or as individual unit. Available for two 40-watt rapid-start lamps or two 96 in. slimline lamps. Units are for 110-125-volt, 425 ma, 60 cycle operation.

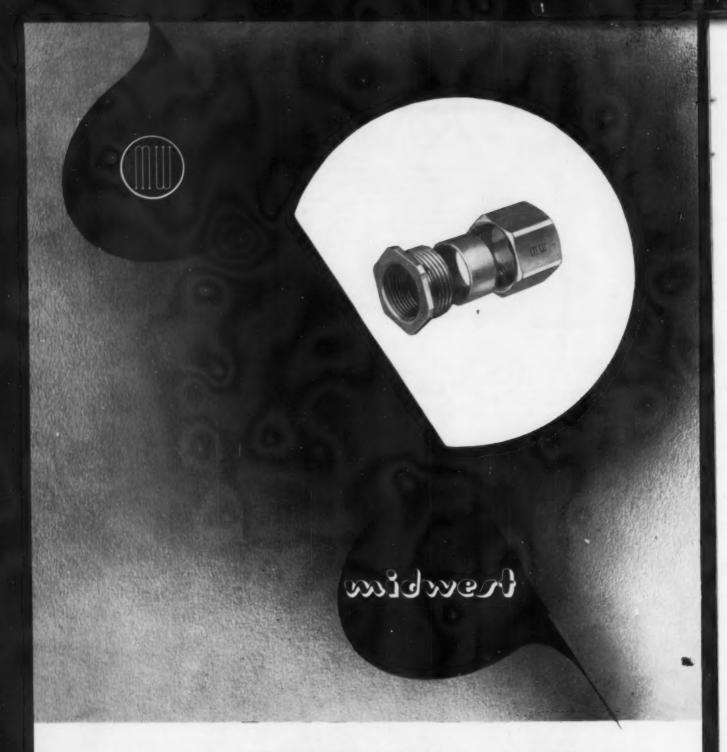
Benjamin Electric Mfg. Co., Des Plaines, Ill. and Pyle-National Company, Chicago 51, Ill.



ower Drive

A new improved power drive, known as the Toledo No. 68, is used for pulling, lifting, threading and turning on a wide variety of jobs. The new streamlined frame is slightly heavier and more sturdy. New ball bearing design improves service life and minimizes maintenance. Unit is easier to hold and safer to operate because of a new handle design and relocation of control switch to a convenient position on the handle. It is powered by a 115-volt reversible ac or dc motor or 90 psi air motor.

Toledo Pipe Threading Machine Co., Toledo, Ohio.

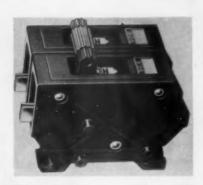


A Midwest quality fitting. "Quality" is just a condensed way of saying: "Getting the total job done — right — with the most inexpensive combination of material and man hours." Engineering and producing quality fittings to meet the highest standards of electrical wiring installations, is our objective at Midwest.

Midwest Electric Myg. Company

MANUFACTURERS OF ELECTRICAL WIRING PRODUCTS

1639 W. WALNUT STREET Chicago 12, Illinois

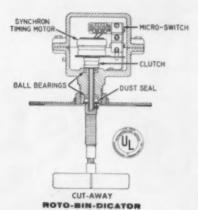


Circuit Breakers

(7)

New two pole "E-Z-Red" circuit breaker is a thermal-magnetic quick make and break, individually trip free circuit breaker for 120-240 volts ac in 30, 40 and 50 amps. The proper time delay is built into the breaker. It is very cool operating, due to the design and heavy cross section of copper current carrying parts, also the heavy copper bussing in the enclosures. When used as a main control in split bus enclosures for lights and appliance circuits, when one of the legs is overloaded, only one pole trips; part of the lighting circuits are still in service. The double pole will fit in all "E-Z-Red" enclosures.

Wadsworth Electric Mfg. Co., Inc., Covington, Ky.



Bin Level Indicator

(8)

A rotating-paddle-type bin level indicator, listed by UL, for use in hazardous atmospheres. This new explosion proof Roto-Bin-Dicator bears UL label for use in hazardous atmospheres Class I, Groups C and D and Class II, Groups E, F & G. Included are: vapors of ethyl ether, gasoline, petroleum, alcohol, acetone, lacquer solvent, natural gas and atmospheres charged with grain dust, carbon black, coal or coke dust, and atmospheres containing metal dust, including aluminum magnesium, and their commercial alloys. It is designed to indicate or control the level of any bulk material that will flow. A low torque

motor, located in an approved explosion-proof housing, rotates the paddle at slow speed. Material building up to Roto-Bin-Dicator stops the rotating paddle and stalls the motor. As the motor stalls, the torque of the motor actuates a Micro switch to control signal lights, horns, motors of conveyors or feeding machinery. Catalog is available.

Bin-Dicator Company, 13946-212 Kercheval, Detroit 15, Mich.



Adapta-Stud

(9)

Adapta-Studs is a new method of installing outlet boxes for lighting fixtures in suspended ceilings. No. 711A has an internal 1-20 standard bolt thread. No. 711B has a 2-16 standard bolt thread to receive the lower end of a rod or bolt that has been attached to concrete ceilings, bar joist or ceiling channels. The external threads of Adapta-Studs are 1-in. standard pipe thread and I-in. standard pipe thread, the 1-in. thread for the 1-in. locknut to hold the outlet box in place and the 1-in. thread for the fixture stem. They may be used without the outlet box as in continuous row multi-stem fixtures.

Tomic Sales & Engineering Co., 20000 Sherwood Ave., Detroit 34, Mich.



(10)

Two new line voltage thermostats have been developed to take the hot "peaks" and cold "valleys" out of electric heating. One does it by fast cycling (up to 20 times per hour), the other by cycling only three to six times an hour. The former (designated T-40) is ideal for low-mass, quick heating-quick cooling units. The latter, (called the T-41) is better suited for large-mass, slow heatingslow cooling systems, such as are used in ceiling and floor cable heating applications. The T-40 is horizontally mounted, is responsive to as little as 0.4 degrees of temperature change, and is designed to cycle up to 15 to 20 times per hour under a normal 50% heating load requirement. The T-41 uses slow cycling periods to achieve a high comfort level when used with large-mass heating elements of the type normally mounted in ceilings, floors, and similar installations. Its operating differential is one degree.

Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.

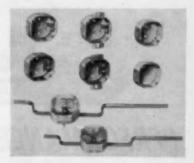


Baseboard Heater

(11)

A new baseboard heater with anodized aluminum heating surface. It is rated for operation at 750 watts, on 115, 208, 230 or 245 volts ac. Unit is in silvertone gray finish to blend with any decor. Safety is assured by low surface temperatures and by concealment of heating element behind the grille. Unit has been approved by UL. Baseboard model is supplied with a built-in terminal block for easy installation. Unit measures 4 ft in length, 8 in. in height, and 21 in. in depth. Where two or more units are to be used in a room, connectors are available, as are inside and outside corner attachments.

Marviray, Inc., 54 Clifton St., New-ark 5, N. J.



Outlet Boxes

(12)

A complete new line of 31-in. octagon outlet boxes and box-bar combinations have been added to this line. Made of heavy gauge steel, they are the standard drawn 11 in. deep. BX clamps are furnished for installing armored cable and flexible metallic conduit, Romex clamps for nonmetallic sheathed cable or non-metallic flexible tubing. Knockouts are 1-in. or combination 1-in .- 1-in. for rigid metallic conduit. The boxes are furnished with either galvanized or baked-on aluminum enamel finish. Adequate nail holes are provided and corners are rounded. Boxes with BX or Romex Clamps and with 1-in. knockouts are offered mounted on either shallow or deep offset bar hangers 19h in. long. Boxes are attached to the bar hangers by sliding iron loops and 1-in. fixture studs. Literature is available.

Keystone Manufacturing Co., 23328 Sherwood Road, Center Line, Mich.





PERFORMANCE · · · · THAT STAYS SOLD

The ultimate buyer is the judge of a product and he can only base his opinion on the performance being rendered. The one thing the buyer doesn't see in a product is the "backbone" or that which is known as quality.

It takes product quality to keep a product sold—build preference for it and establish your reputation for reliability.

Quad RLM Reflectors assure you of customer approval. They conform to the nationally-recognized illuminating engineering standards for industrial lighting equipment.

e See the complete line in our reflector catalog No. 10

QUADRANGLE MFG. CO.

32 S. PEORIA ST.

CHICAGO 7, ILL.



Lighting Unit

(13)

A new 48-in. linear low brightness mercury luminaire for use on streets and highways. It produces all the commonly used IES standard street lighting patterns. Styled and engineered for the most modern streets and highways, this new mercury unit has all the low brightness characteristics of fluorescent street lighting luminaires, but exceeds fluorescents in efficiency and control.

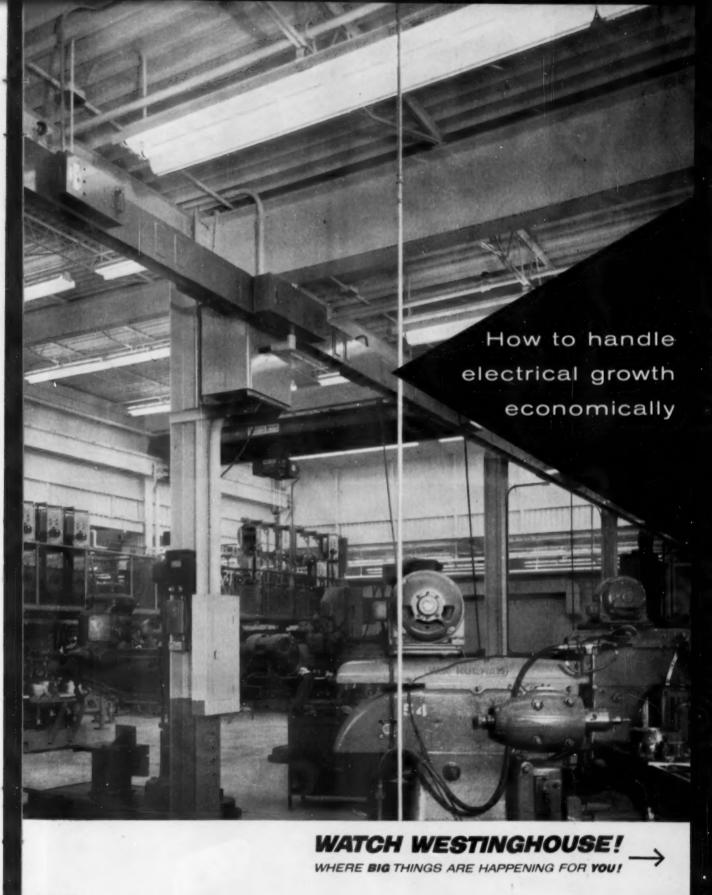
Wheeler Reflector Company, 275 Congress St., Boston 10, Mass.

(14)



MODULAR molded case circuit breakers and standardized enclosures simplify distribution panelboard installation. IIlustrated at top: The complete line of Type AB Stabreakers, ranging from the 11/16-in. single pole type E at extreme right, to the 225-amp 3-pole type J at left. Lower left: Four different panel assemblies with single and double bussing accommodate E, F and J frame Stabreakers with main capacities up to 600 amps. Branch circuits required determine the panel assembly needed. Lower right: Installation of Stabreakers is a simple plug-in operation. They are supplied in all standard ampere ratings up to 225 amps, 600 volts.

Manufactured by Federal Pacific Electric Co., 50 Paris St., Newark 5, N. J.



Here's a Power Source Born With Expansion Plans

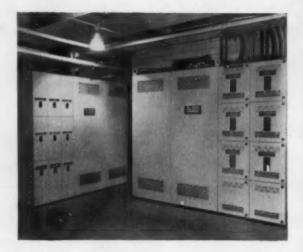
The very fact Westinghouse power centers are conceived with your expansion plans in mind helps you handle electrical growth economically. The secret is "Unitized" design.

New breaker compartment units literally "snap" into place, no matter whether one or a dozen are added. If you have a Westinghouse power center with spare enclosures you need only add the breaker. It's that simple.

But even if you never add one more piece of equipment your investment will begin to pay dividends immediately. These power centers cost less to install because they are assembled in the Westinghouse factory; using high-voltage power close to the load, you eliminate costly runs of secondary lines and you save on actual power because no long wire runs eat up voltage.

If you use a dry-type transformer, no special, expensive vault is needed. Mount power centers anywhere, out of the way. Think of the extra floor space made available. Ask your Westinghouse representative for power center details today.

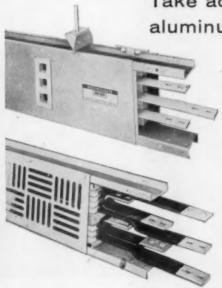
DP 5026-B







Take advantage of aluminum bus duct's 15-25% cost savings



DP 5026-C

Aluminum bus duct by Westinghouse is your best distribution material and its delivered cost is now 15-25% lower than copper duct. Besides this savings Westinghouse guarantees the same top quality and performance and longevity with aluminum built into copper-bar bus systems.

If you already have a bus duct system, new runs of aluminum duct can be added to meet growing electrical distribution demands. At substantial installation timesavings as well. Up to 35% less weight in aluminum makes it handle easier, go up faster.

If you have never used bus duct, seriously consider these benefits: prefabricated sections that make hanging hours faster; prefabricated fittings to run duct in any direction or around obstructions; salvageability up to 100% when system changes occur; neat appearance; and as much as two-thirds less space required than for cable and conduit.

Write today for additional information. Ask for booklet B-6740. Write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. And remember, you can be sure if it's Westinghouse.

WATCH WESTINGHOUSE!

WHERE BIG THINGS ARE HAPPENING FOR YOU!



Save up to 40% labor costs with Westinghouse control centers

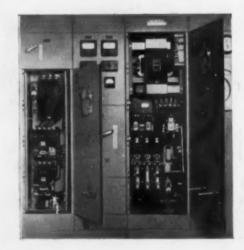
A Westinghouse control center installation requires about 40% less labor costs than a decentralized method of control. A saving in time and material you can't afford to be without.

This is possible because an entire control system is contained in one unified structure. Gone are the costly drawbacks of scattered controls. And when economic growth demands more control apparatus you can count on the same savings.

Under this setup, servicing is easier, too. One or a few authorized men can supervise all operations.

Dead-front construction, and the fact that they are housed in a single unit apart from working areas, creates a condition of safety which actually improves the working atmosphere and personnel morale.

Your Westinghouse representative can give you more reasons why you should include a modern control center by Westinghouse in your next project. Remember, you can be sure if it's Westinghouse.



Switch to mercury to double light output without rewiring



Many plants have found their incandescent lighting systems loaded to capacity. One solution is to rewire the entire system at no little expense. The best answer is to switch to mercury lighting. Westinghouse High-Bay mercury lighting.

By this method you can double light output for the same wattage and completely eliminate the need for rewiring.

But Westinghouse has built in other plus features in High-Bay lighting that make it even more advantageous to use. For example, these rugged units are virtually maintenance free. Air circulation through an opening between the neck and reflector sweeps the reflector surface clean. Remember this, next time you contemplate an installation over 20 feet from the floor.

For a lot of other pertinent facts about Westinghouse mercury High-Bay lighting ask the Westinghouse man in your locale. You can be sure if it's Westinghouse.

WATCH WESTINGHOUSE!

WHERE BIG THINGS ARE HAPPENING FOR YOU!

DP 5026-E



Slashes bending costs!



ELECTRIC POWER PIPE BENDER

more than triples output

Speed-minded contractors and crews everywhere are changing to Blackhawk Hydraulic Pipe Bending Tools. And here are the solid reasons why they're so popular. With S-132 Hydraulic Bender, you can put a 90° bend in 2" pipe in less than 60 seconds! To turn out production bends three to six times faster, simply use a P-182 Blackhawk portable, electrically-driven hydraulic pump. It costs only \$325.00 and can pay for itself on the first job. Can be used with "Porto-Power" or any other hydraulic equipment.

These same cost-conscious contractors are finding that the new Blackhawk feather-weight aluminum alloy S-130 kit obsoletes all other equipment for bending ½ through 2-inch rigid conduit and pipe. They like new "Optik-Angle" gauges that eliminate guesswork — new longer stroke ram that extends to full 10 inches. Time-saving new removable top plate — "lock-on" shoes speed setups — eliminate need of threading shoes on ram.

For better morale, better work and better business see your electrical wholesaler or industrial distributor-today. Write for free descriptive literature . . without obligation. BLACKHAWK MFG. CO., Dept. P-20106, Milwaukee 46, Wisconsin.



Popular new \$-130 hund-operated bender slashes bending costs . . . makes 90° bends in one set-up.



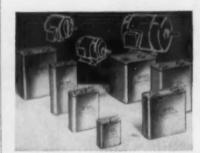
New hydraulic knockout punches work anywhere. Speedy hydraulic unit is 9 lbs. lighter, lower in cost.

Heating Unit

(15)

An electrically operated radiant glass heating and drying unit for the bathroom. Built-in thermostat insures correct temperatures. This model, with two towel bars, will warm towels and dry stockings, gloves, lingerie, etc. Also may be used as hair dryer. It is 18½ in. wide by 25½ in. high and ½ in. deep. Unit may be had in chrome finish, neutral hammertone silver finish or in a baked-on oxide for finished painting on the job. Rating is 625 watts, 120 and 240 volts ac only. Comes with detachable chromium plated guards. May be surface mounted or recessed.

Continental Radiant Glass Heating Corp., 1 East 35th St., New York 16, N. Y.



Capacitors

(16)

The largest selection of ratings for ac applications, and smallest case sizes for the ratings in this style of capacitor, are main features of the new Type KGN rectangular fabricated-case units. The KGN series is available at 236, 330, 440 and 660 volts ac, 60 cycles, in capacitance ranges from 1.0 to 60.0 mfd, depend-ing on voltage. Applications include motor-running in split-phase capacitor motor circuits such as in air conditioning, refrigeration equipment, fans, blowers, business machines; also fluorescent lamp ballast applications and many general purpose ac uses. Other features are: safe operation with use of non-flammable, non-explosive Dykanol impregnants; availability of Dykanol J low-temperature impreg-

BLACKHAWK

WORLD'S LARGEST MANUFACTURER OF HYDRAULIC TOOLS





TRUCO Drills 2½" Holes in 90 Seconds on 8,400 Outlet Electrical Project

JOB: Penetrate $3\frac{1}{2}$ " concrete cap over cellular steel flooring for $2\frac{1}{2}$ " dia. electrical outlets at Ford Motor Company's new Administration Building. 8,400 holes required to bring in electrical, telephone and inter-com wiring for offices.

CONTRACTOR: Harlan Electric Company, Detroit

TOOLS: Truco Diamond Drilling Machine equipped with 750 RPM Motor and $2\frac{1}{2}$ O. D. Truco Diamond Drill Bits. (Machine was also used for horizontal drilling.)

DESCRIPTION: Spotting crews located outlets and cut the rubber floor tile with a circular saw. Portable rubber-tired Truco Diamond Drilling Machine then drilled through concrete in 90 seconds per hole. Complete cores were lifted out leaving smooth, perfect holes, requiring no patching or finishing. Finished floor undamaged by drilling operation.

Picture shows Truco vacuum water pick-up removing cuttings and coolant water as Truco unit is drilling. Because Truco is dust-free and relatively quiet, drilling was done in occupied sections of the building without disturbing tenants.

Job superintendent reports, "No other equipment could do the job the diamond drill performed on this project. It shaved weeks off our schedule and reduced our drilling costs materially."

WRITE FOR NAME OF NEAREST DISTRIBUTOR

WHEEL TRUEING TOOL CO.

95-3200 W. Davison Ave.

Detroit 38, Michigan

nant for maintenance of capacitance down to minus 40°C; low power factor, high insulation resistance and high voltage-breakdown. Three standard terminal assemblies are available, offering several combinations of lug styles with insulator cups or flat insulating washers. Bulletin No. 179 is available.

Cornell-Dubilier Electric Corp., South Plainfield, N. J.



Clamps and Fittings

(17)

A new line of outdoor bus support clamps and fittings for use with cable, tubing, or bus bar. Clamps are available for either 3-in. bolt circle, standard strength or 5-in. bolt circle, high strength insulator mounting. New clamp line accommodates cables from No. 1 to 2000 MCM, tubing from 1 to 21 in. IPS, and bus bars from 2 to 6 in. wide. The entire range of cable sizes can be handled by a clamp consisting of two similar parts. For supporting tubing or bus bar, clamps are provided with slotted mounting holes, allowing convenient angular adjustment to assure proper alignment of clamp and conductor. Clamps can be furnished all ferrous, half ferrous and half bronze, and all bronze. They can be mounted upright or inverted on cap and pin or station post insulators.

Line Material Co., Milwaukee 1,

Pipe (18

A new line of light wall polyvinyl chloride pipe with a uniform pressure rating in all sizes, known as Schedule PR-150 series. There are two basic types in this series. One has high chemical resistance and a maximum working pressure of 150 psi at 75°F. The other has high impact strength and a rating of 125 psi at the same temperature. These two working pressures are constant in all pipe sizes. This pipe, a rigid unplasticized material, is available in eight sizes ranging from 1-in. to 4 in. Wall thicknesses range between .060-in. and .230-in. All pipe is furnished in standard 10 and 20-ft lengths with plain ends.

The Carpenter Steel Co., Alloy Tube Div., Union, N. J.

Recessed Lighting



Sylvania Recessed Troffers—mounted in continuous rows, 6 feet apart, bring high foot-condle levels with clean, smart design to modern offices of Consolidated Vacuum.

"10% UP" Lighting



Sylvania NTWS Series—semi-direct industrial flatures with 10% upward light maintain high foot-candle level comfortably, at low initial and maintenance cost. RLM-approved.

Right combination of foot-candle levels helps Consolidated Vacuum build better vacuum equipment

INDUSTRY and research often require accurately made, measured and maintained pressures as low as 1/50,000,000 of a pound per square inch. Consolidated Vacuum, of Rochester, N.Y., is one of the primary sources of the precision vacuum equipment needed.

To be sure of top employee efficiency and performance on the job, Consolidated insisted on adequate foot-candle levels in all working areas. For offices, they selected Sylvania recessed troffers fixtures to do the job... get a clean ceiling design which harmonizes with the modern décor as well.

In the plant, Sylvania NTWS industrialtype fixtures give their highly skilled, well-paid machinists and technicians the same adequate lighting levels. Slots in the tops of the open reflectors direct a full 10% of the fixtures' light up to the ceiling. This softens sharp contrasts overhead, reduces eye-straining shadows and glares at working level. The upward light also improves the over-all illumination efficiency of the fixtures.

In close-work areas, where seeing tasks are critical, Consolidated has the fixtures mounted in continuous rows, 12½ feet between centers. But in storage areas,

where slightly lower foot-candle levels are needed, the fixtures are spaced out along the rows.

This installation is but one example of how a complete lighting plan can be tailored to your plant's needs from Sylvania's complete line of fixtures. Planned lighting can help you improve quality and quantity of production; boost morale and safety records, too. We invite you to talk to the Sylvania lighting specialist in your area.

SEND COUPON FOR HELPFUL DATA



. . . fastest growing name in sight

LIGHTING . RADIO . ELECTRONICS . TELEVISION . ATOMIC ENERGY



Sylvania	Electric	Product	s Inc	
Dept.K-4	O, Light	ing Divis	sion-	-Fixture
One 48th	St., Wh	ecling, \	West	Virginia

- ☐ Please send me helpful catalogue sheets and data on your complete line of fixtures for industrial use.
- ☐ Please send me a copy of your informative booklet on office lighting, "Good Lighting Is Good Business."
- ☐ Have a Sylvania lighting specialist call on me.

Name	Title	
, , , , , , , , , , , , , , , , , , , ,		

Address			

-	Organization		 	

___ Zone___ State___



... new lightweight Greenlee Hydraulic Bender for 1/2"- 2" conduit

easily portable . . . makes 90° bend with one ram stroke

"Because it is easy to handle and transport from job to job . . . because it will make a 90" radius bend with one thrust . . . and because of its thin-wall attachment obviating the need for buying manufactured bends, we selected the new Greenlee No. 880 Bender," says C. E. Rose of Rose Electric Co.

And, since having this new lightweight Greenlee Hydraulic Bender on the job, this company reports substantial savings of man-hours and complete elimination of conduit spoilage and need for manufactured bends.

You, too, will welcome the easy portability of this advanced type bender. One man can easily carry and operate

easily carry and operate it... make smooth, accurate bends in ½"-2" conduit or pipe in just a few minutes.

With light, but strong aluminum alloy used for many parts, weight of this new tool has been greatly reduced so that it can be carried by hand or simply pushed along on its pipe supports which serve as rollers. Two-speed hydraulic hand pump with special speed coupling on the hose and pump means simplified

handling, fast setup.
And with its attachments for thin-wall conduit, tubing, and bus bar, the No.
880 Bender can make almost any type

of bend in all types of material within its size range. A complete 90° bend can be made with one ram stroke.

Designed for easy hand operation, this new lightweight bender can also be teamed with a GREENLEE Power Pump for fast production jobs. Get the complete story now on this highly versatile new bender, see how it can be one of the best tool investments you've ever made! Write for folder E-217.



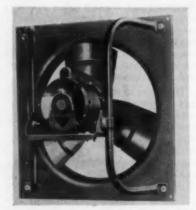


Switch

(19)

A single rectangular touch button styled to conform to any decor, Touchette, a new touch-action wall switch, has quiet, easy operation. A gentle touch of finger, hand or elbow switches lights and appliances on and off. It fits both standard toggle wall plates and standard outlet boxes. It operates on full line voltage, without relays, transformers, or mercury, and no special wiring is required. Silver is used for contacts. The cam and ratchet are made of wear-resistant nylon. All other internal parts are made of brass and bronze. Entire mechanism is enclosed in a thermo-setting plastic case. Rated at 15-amp, 120-277-volt ac, Touchette is designed to operate either incandescent or fluorescent lighting system at full rated capacity or motor loads up to 80% of rated switch capacity. UL approved, it can also be used in the new 277/480-volt systems. Available in single pole, double pole, 3-way and 4-way models, with either brown or ivory touch button.

Rodale Manufacturing Co., Inc., Emmaus, Pa.



Exhaust Fan

(20)

A new heavy-duty propeller type exhaust fan designed specifically for industrial installations. Designated Model "K" Ventura fan, the unit is available with 2-speed or constant speed direct drive totally enclosed motors. A large range of sizes are

GREENLEE TOOL CO., 1750 COLUMBIA AVE., ROCKFORD, ILLINOIS



able with other devices of the same type for replacement purposes.

Devices fit standard boxes and wall plates. Available in brown or ivory phenolic. Newly designed wall plates in metal or phenolic are simply styled, easily cleaned. Listed by Underwriters' Laboratories.

Your best jobs are done with



For full information write; LEVITON MANUFACTURING COMPANY . BROOKLYN 22, N. Y.

Chicago . Los Angeles . Leviton (Canada) Limited, Montreal For building wire and cable contact our subsidiary AMERICAN INSULATED WIRE CORPORATION



a host of other advantages enthusiastically received by lighting engineers everywhere. Everything about the Luminaire is precision built! The housing is of precision, die-cast aluminum alloy. The reflector is of one-piece W-Modified Parabolic design which offers sharp, vertical cut-off and proper I.E.S. distribution patterns without the use of lifting prisms. You obtain fullest utilization of lamp output. Reflector cannot be inserted wrong. Perfect alignment assured at all

Integrally cast "lift-off" type hinge allows easy removal of glass.

Compression-type, die-cast aluminum alloy holding ring allows for expansion and contraction of the glassware without strain. Springloaded roller latch automatically clamps lens ring and holds glassware

tight — no dust or bugs can enter.

All the above, coupled with lightness in weight, greater strength, more attractive size and shape, finer finish, ample wiring area and simple terminal connections make the New Revere "Endoval" tops in design - tops in performance and tops in value. Investigate today. Write for Brochure 700-9.

REVERE ELECTRIC MFG. CO. . 6009-17 BROADWAY . CHICAGO 40, ILL. Available in Canada thru Curtis Lighting, Ltd., Leaside, Toronto, Ontario

THE ONLY COMPLETE LINE OF LUMINAIRES - FLOODLIGHTS AND POLES FOR STREET - SPORTS LUMPORT - SERVICE STATION - OUTDOOR THEATRE - MARINE AND INDUSTRIAL LIGHTING

offered with capacities from 587 cfm to 12,800 cfm. The new design will operate against static pressures up to I-in. A square mounting panel contributes to ease of installation.

American-Standard Products (Canada) Limited, Canadian Sirocco Products, Box 39, Station D, Toronto, Canada



Infrared Oven

(21)

Radiant heating units suitably designed for research and testing purposes. Illustration shows a small quartz lamp oven in a typical design for laboratory use, 16 in. deep with an opening of 131 in. It holds eight 1600-watt quartz lamps. At maximum operation with full voltage used, the connected load for this oven is 12.8 kw. It is available as a complete unit including switch, ventilation blower, lamps and two hinged doors at front. Back of oven is closed, and interior is lined with specular gold plating. Literature is available.

Fostoria Pressed Steel Corp., Fostoria, Ohio



Amplifier

(22)

Two new sound power amplifiers, 70watt types designed to increase the flexibility and usefulness of industrial sound systems in schools, institutions, industrial plants, and indoor and outdoor amusement centers. They feature frequency responses of 50 to 15,000 cycles, and are engineered for a power output of 70 watts with low distortion. They also feature constant voltage output with balanced or unbalanced 70 volts output. One model (SA-74A)

Now...immediate in-warranty replacements on Sola fluorescent ballasts from your local wholesaler

No red tape! No delay! No cost!



Revolutionary new Sola Ballast Service Plan enables you to get in-warranty replacements from any qualified electrical wholesaler, immediately and without cost.



Just what is the new

Sola Ballast Service Plan?

It is a revolutionary new plan for making in-warranty replacement of a defective Sola ballast. You, as an electrical contractor can get immediate replacement, locally, from any qualified electrical wholesaler in the United States who stocks certified CBM ballasts for over-the-counter sale. Your wholesaler does NOT have to purchase or stock Sola ballasts to participate in the plan. He can make a replacement with any equivalent certified CBM ballast.

Who benefits by the new Sola Ballast Service Plan?

The Electrical Contractor benefits because he receives an immediate, free replacement for any in-warranty defective Sola ballast from his local wholesaler. You keep *your* customers happy with your service.

The User benefits because there's absolutely no delay in getting a new ballast to return his fixture to top working order, anywhere in the United States, without delay, without red tape.

The Electrical Wholesaler benefits because he is able to provide an additional service, at no charge to you, his electrical contractor customer. He does not require any additional ballast stock, either.

The Fixture Manufacturer benefits because he is assured that the ultimate user, regardless of location, will get quick ballast replacement service in restoring his fixture to perfect operating order in those rare instances when a Sola ballast fails.

The Quality Standard of Sola Ballasts

The Sola Ballast Service Plan is made possible because Sola ballasts have an exceedingly low failure ratio. Less than 14/100-of-1% of all Sola ballasts fail in warranty, and less than 9/100-of-1% of Sola Rapid Start ballasts fail in warranty, according to carefully maintained records. This unusually low failure rate is due to Sola's policy of maintaining exceptionally high standards of quality in engineering and manufacturing.



1. Should you find a Sola ballast which has become defective within the warranty period, return it to any qualified electrical wholesaler in the United States. The wholesaler will check the date of manufacture stamped on the ballast cover. If the ballast failed within two years of its manufacturing date, it is considered "defective in-warranty".



2. Your electrical wholesaler is authorized by Sola Electric Co. to replace at no charge the defective in-warranty Sola ballast with another Sola ballast if he has it in stock. If not, he refers to a Cross Index Replacement Guide, provided by Sola, to find an equivalent certified CBM ballast of another make.

3. Your wholesaler will immediately give you the certified CBM replacement unit from stock. You sign a receipt for it. There is absolutely no charge to you, no red tape, no delay. You get your replacement immediately.



4. Because the replacement was made through your local wholesaler, no time was lost in ordering or waiting for delivery. Your customer will appreciate the fast service in restoring his fixture to perfect operating order.





Send for FREE Sola Cross Index Ballast Replacement Guide

This valuable chart lists Sola ballasts and certified CBM equivalents. In addition, the chart shows you how to quickly and easily determine if any Sola ballast is in-warranty. This handy chart folds to $8\frac{1}{2}$ " x 11", is pre-punched to fit your standard 3-ring notebook.

Your Local Electrical Wholesaler Can Help You NOW

Electrical wholesalers all over the country have been authorized by Sola Electric Co. to immediately replace, at no charge to you, any inwarranty defective Sola ballast. Feel free to take advantage of this Sola Electric Co. service if the need arises.

Watch for future advertisements listing Sola Ballast Service Centers. Chances are, your regular electrical wholesaler is participating in this new plan and will be listed, even if he does not stock Sola ballasts. He is authorized to make any in-warranty replacements with an equivalent certified CBM ballast, of another make if necessary, to give you fast service with no red tape, delay or cost.

It will pay you to do business with a Sola Eallast Service Center. You'll get better, quicker ballast service for yourself and your customers. And this extra in-warranty replacement service costs you and your customer nothing.

Ask your local wholesaler for a Sola Cross Index Ballast Replacement Guide. He will be glad to give you one, free. If he has none on hand, remind him that he can get a free supply of charts from Sola Electric Co. for distribution to his customers. If you prefer, you can obtain your Cross Index Ballast Replacement Guide by filling out the coupon below and sending it directly to Sola Electric Co.

SOLA

4633 W. 16th St., Chicago 60, III. Bishop 2-1414

TO: SOLA ELECTRIC CO. 4623 West 16th St., Chicago SO, III.

Please send me, without any cost or obligation, the "Sola Cross Index Ballast Replacement Guide."

My name____

Address.

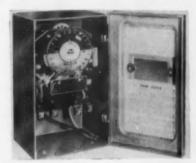
City Zone State

My Regular Wholesaler:

(Wholesaler's address)

provides inputs for four microphones and one phonograph; the other (SA-72A), two microphones and one phonegraph. Both are designed for applications involving either high or low impedance, and can be adapted for low impedance with available plug-in RCA input transformers, 50-ohm and 250-ohm types. Other features include: electronic circuitry which mixes microphone and phonograph input in advance of tone control; individual volume control for each input; a master gain control, bridging input and output: auxiliary ac outlet and screw terminals on chassis for audio output connections; separate base and treble controls; magnetic pickup equalization; heavy-duty mounting in a steel case.

Radio Corporation of America, Camden, N. J.



Time Control (23)

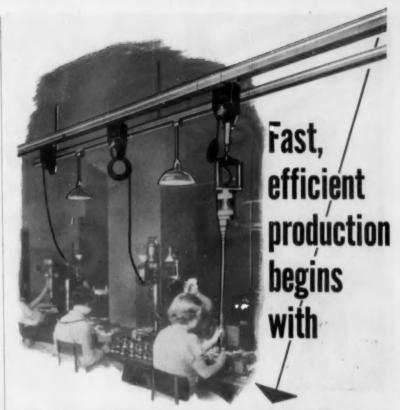
All-night lighting on selected days of the week is now available in one completely-automatic control. By combining two Tork time controls in one unit, it is possible to have lights go on automatically at sunset on any selected days of the week. This is achieved through the combination of astronomical dial and new Skip-A-Day control. Should lighting be required only five nights a week, as in parking areas, supermarkets, or display signs, the Skip-A-Day wheel is used to control the astronomical dial. Designated as "ZSK", the combination is available on single pole, double pole, three pole, and double throw switches.

Tork Clock Co., Inc., Mount Vernon, N. Y.

Ballasts (24)

A complete line of shallow height ballasts for 430 ma T12 slimline lighting systems. Latest in the line is a fluorescent lamp ballast for operation of one 8-ft instant-start lamp that gives protection against end-of-lamplife rectification damage. All ballasts are 13½ in. in height. Included in the shallow height line are ballasts for 48T12, 72T12, and 96T12 lamps in single and 2-lamp fixtures. All are high power factor, UL approved and CBM certified.

General Electric Co., Schenectady 5, N.Y.



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That's because FEEDRAIL Trolley Busways over your production, assembly and test lines...

- provide mobile outlets for electrical machines and portable tools where they're wanted.
- eliminate long, dragging cables that endanger personnel and hamper their work.
- * keep electrification and tools off floor and benches ... away from the danger zone.
- · enable quick tool changes without cutting off power.

Safe, smooth-flowing, time-saving production is the result — a result you can get in your plant. FEEDRAIL Trolley Busways are surprisingly easy to install in operating plants as well as new ones. And they're just as readily modified or moved to meet changing production requirements.

When you install FEEDRAIL Trolley Busways you're sure of maximum safety, adaptability and reliability in electrical power distribution.

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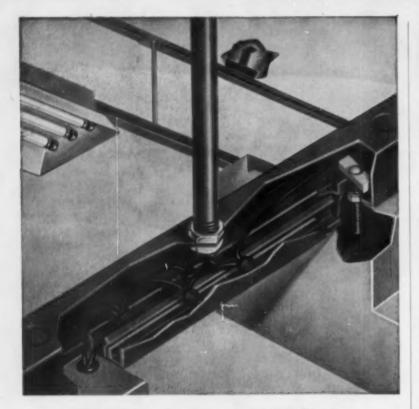
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FEEDRAIL CORPORATION

Subsidiary of Russell & Stoll Company, Inc. 125 BARCLAY STREET . NEW YORK 7, N. Y.



New, low-cost way to hang a fluorescent fixture

Mult-A-Frame It!

SAVE TIME, MONEY AND MATERIALS: MULT-A-FRAME, the new, fully-locking Bonderized steel frame with baked enamel finish, is ideal for supporting fluorescent fixtures. Special fittings such as the new raceway T-bolt and concrete inserts make fluorescent fixture hanging quicker and easier than ever before.

NO WELDING, NO DRILLING, NO SCRAP: only tools needed to MULT-A-FRAME are a saw and wrench. And as needs change, MULT-A- FRAME can change, too. It's completely reusable. No waste.

cuts your LABOR COSTS: no skilled labor is required to MULT-A-FRAME. You get safe, strong fixture suspension quickly while keeping on-the-job labor cost to a minimum.

send today for your free copy of the MULT-A-FRAME illustrated brochure.

"Hold Everything."



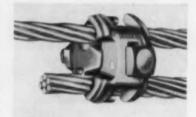


Lighting Units

(25)

The Modu-Glo II series is a com-plete surface mounted lighting line designed around a modular system of triangles, rounds and squares. For use in any style home or office. All three units are available in 100- and 150watt, with either one of three diffusing elements-a molded opal drop milk white glass diffuser of low brightness; a flat Albalite milk white glass diffusing panel; a wide angle Marco designed fresnel type lens. The three shapes were designed as modules having the same basic dimensions so that they might be used in "clusters" of identical units or in combinations. Units will fit either 3- or 4-in. outlet boxes, are available in any one of the following finishes: polished chrome, copper, brass or oyster white.

Marvin Electric Manufacturing Co., 648 South Santa Fe Ave., Los Angeles 21, Calif.



Clamps

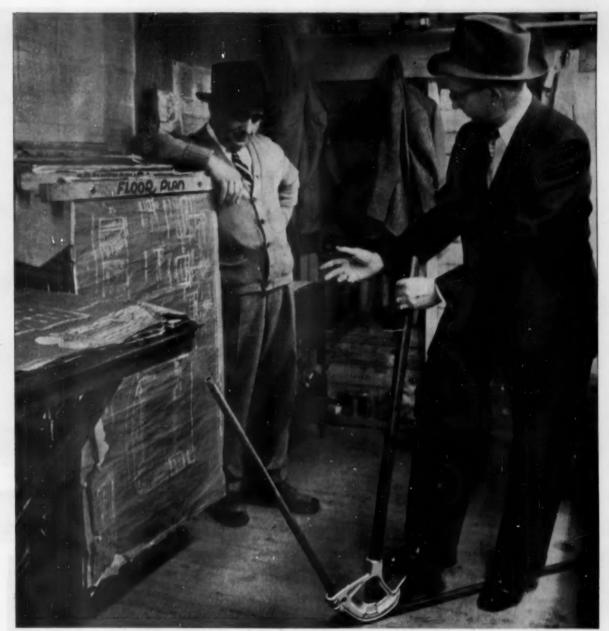
(26)

A new line of aluminum Universal clamps, featuring the use of a stainless steel Belleville spring washer, which counteracts cold flow of soft aluminum conductors and maintains uniform clamping force during heat cycling. This clamp utilizes a square head bolt which permits tightening with either one or two wrenches. Clamps are available with a special oxide inhibiting coating.

Dossert Manufacturing Corp., 249 Huron St., Brooklyn 22, N. Y.

Switch (27)

A new tap-acting switch that can be used with conventional wall plates and a 4-gang decorator wall plate. Both units, known as "Tap-Lite" switches are designed for large residential installations and commercial buildings. Switch has a single rectangular actuator button. This makes it suitable for use in wall plates which



Redege Benfield Bender used in demonstration

We had <u>lost</u> the order... then our salesman started bending pipe

We had lost a big order on price—almost. Then our salesman got mad. He decided to prove that Sherarduct rigid steel conduit should be specified. So he went out and picked up a bender and some lengths of Sherarduct. Back in the customer's office he started making bends . . . then the customer tried a few himself.

Result: we got the order. The customer didn't need an adding machine to figure out the savings in labor he'd get from Sherarduct's easy bending qualities.

Easy bending is one reason Sherarduct is preferred by so many cost-conscious contractors. There are others, like easy fishing, lifetime protection against corrosion, zinc protected threads, strong couplings and thorough grounding. They're features that add up to why Sherarduct is galvanized conduit at its best.

Next time an NE salesman calls, give him a chance to prove Sherarduct—by actually bending some pipe.

Meantime, write for our Sherarduct facts book and get complete information on the Sherardizing process of dry galvanizing that actually alloys zinc with the steel wall of the conduit.

Listed by Underwriters' Laboratories, Inc.

National Electric Products

PITTSBURGH, PA.
3 Plants • 10 Warehouses • 36 Sales Offices





2 EXCLUSIVE FEATURES
that make
Republic Electrunite E.M.T.
easier to install



INSIDE KNURLING makes wire-pulling easier, too!

Another exclusive feature available on all popular sizes. Republic's exclusive ball-bearing inside surface is the secret. Makes wire-pulling up to 30 per cent easier.



REPUBLIC



World's Widest Range of Standard Steels

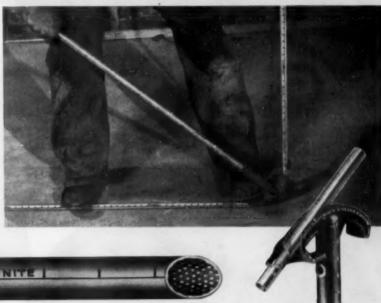
"INCH-MARKED"

Length of tube is marked in feet and inches on all popular sizes. You simply align proper mark on the tube with calibrations on the Republic Bender to obtain precisely the right height of bend.



"GUIDE-LINED"

Extends full length of tubing. By lining up with arrows on Republic Bender, it is easy to help keep bends in the correct plane, avoid costly "wows." With Guide Line and "Inch-Marks", accurate, properly located bends are easy to make—every time. On all popular sizes.



ELECTRUNITE

Thanks to these highly popular features, electrical contractors all over the country are using more and more Republic ELECTRUNITE* Electrical Metallic Tubing in all types of installations. They like the ease of installation—the good results—the savings in time and tubing.

Ductile, smooth-bending, top-quality Republic E.M.T. makes it easy to meet schedules for any type of construction. It's 100% approved

for concrete-slab construction by the National Electrical Code.

On your next job, regardless of size, you can reduce waste and costs by installing Republic ELECTRUNITE "Inch-Marked" E.M.T. When ordering from your electrical distributor just ask for Republic—the E.M.T. that's "Inch-Marked" and "Guide Lined." Send coupon for literature providing complete information.

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Please send me literature on Republic ELECTRUNITE "Inch-Marked" E. M. T.

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Company

Company

Address

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NOW BEING MADE IN SIZES BIGGER THAN 1%" IN DIAMETER



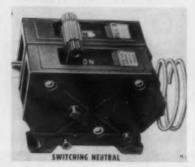
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WESTERN INSULATED WIRE COMPANY

Los Angeles 58, California

also contain an appliance outlet; also for mounting in five, six, or more gang plates of the type found in larger buildings. The 4-gang decorator wall plate is used with conventional (round-button) Tap-Lite switch, made of transparent plexiglas. It is flush mounted and features screwless, snapon mounting.

Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.



Switch Neutral

(28)

The switching neutral "E-Z-Red" circuit breaker is a two-pole breaker. One pole is an independent individually tripped thermal magnetic circuit breaker, for protection against overloads, etc. The other pole is an independent non-automatic disconnect switch for disconnecting the neutral. A wired-in lead is also provided to connect the switch to the neutral in the enclosures. The two poles work simultaneously when operated manually. It meets the requirements of the NEC (1953 edition) article 510, section 5120e and is also listed by UL.

Wadsworth Electric Mfg. Co., Inc., Covington, Ky.

Electronic Range

(29)

A new electronic range designed for built-in installation. Overall dimensions are 23% in. wide, 26% in. high and 22% in. deep. The interior is 17% in. by 11 in. by 13% in. The exterior is of polished chromium with brushed chrome door panel and escutcheon. Four eye-level chrome dials permit instantaneous control of the various functions. A main control dial starts and stops the operating energy. A Hi-Lo Microwave dial regulates power consumption of 3,100 and 2,400 watts respectively. As cooking is done by energy, rather than by heat, there is no temperature control. A microwave time selector automatically regulates cooking time. This ranges from a few seconds to a maximum of 21 minutes. When the pre-determined time has elapsed the energy is automatically switched off and a bell chime rings. It requires no pre-heating and may be plugged-in to any 220-volt ac power outlet. Unit operates on 2450 mega-cycles, at the rate of one million microwaves per second.

Whirlpool-Seeger Corp., St. Joseph, Mich.

Take Abuse

Natvar Products

- · Varnished cambric-cloth and tape
- · Varnished canvas and duck
- Varnished silk and special rayon
- Varnished—Silicone coated Fiberglas
- · Varnished papers—rope and kraft
- · Slot cell combinations, Aboglas® Isoglas sheet, tape, tubing and
- sleeving
- · Vinyl coated-varnished-lacquered tubing and sleeving
- · Extruded viny! tubing and tape
- Styroflex flexible polystyrene tape
- Extruded identification markers

Ask for Catalog No. 23

Utilities today are doing an outstanding job of keeping up with the relentlessly increasing demand. In the race to serve wider areas, and areas of doubled density, distribution transformers have had to handle loads far in excess of rated capacity for long periods without interruption of

Principal manufacturers of distribution transformers rely upon Natvar 500 Extruded Vinyl Tubing to insulate and protect high voltage leads. It is resistant to heat and oil, and does not impair the properties of transformer oil. Natvar 500 was formulated expressly as high voltage lead insulation in oil filled transformers. It is manufactured in sizes and wall thicknesses dictated for this service.

Natvar 500 and other Natvar flexible electrical insulating materials are available for immediate delivery, either from wholesalers stocks or direct from our own. Full data on request.



service.

CORPORATION

RODUCTS CORPORATION CABLE ADDRESS

FULTON 8-8800

NATVAR: RAHWAY, N. J.

205 RANDOLPH AVENUE . WOODBRIDGE, NEW JERSEY

ELECTRICAL CONSTRUCTION AND MAINTENANCE . . . OCTOBER, 1956



PROTECT against Line Disturbances



REDUCED VOLTAGE **STARTERS**

SATISFY POWER COMPANY REQUIREMENTS



SIZE 2 30 H.P.

TYPE "TRA" **AUTO-TRANSFORMER STARTER** FOR GREATEST POSSIBLE STARTING TORQUE

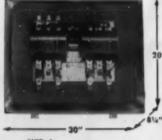
FEATURING: Advanced design, lighter, more compact with straight-thru wiring. Rugged auto-transformer with taps easily adjustable for desired voltage. Adjustable accelerating pneumatic relay. A-H bi-metallic thermal overload relays.

AVAILABLE: In NEMA Sizes 0 to 5, from 5 to 200 hp. NEMA I (General Purpose) or NEMA XII (Industrial)

TYPE "IRA" INCREMENT STARTER

FOR PART WINDING SQUIRREL CAGE MOTORS

Reduce current inrush on light or low-inertia starting loads by 2step method . . . second winding energized after an adjustable time lag.



ECM

AVAILABLE: In NEMA Sizes 1 to 5, up to 400 hp at 440/550 volts. NEMA I or NEMA XII Enclosure.

These A-H Starters provide automatic operation with either 3-wire control or 2-wire thermostat control systems. Supplied with 3 poles for polyphase service, 4 poles for 4-wire service.

USE THIS COUPON TO SEND FOR COMPLETE INFORMATION



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INDUSTRIAL	CONTROL	DIVISION

THE ARROW-HART & HEGEMAN ELECTRIC CO. 103 HAWTHORN STREET, HARTFORD 6, CONNECTICUT

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- A-H Reduced Voltage Starters.
- The complete line of A-H Heating, Ventilating and Air Condi-

Othere	
Others	-

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Product Briefs

(30) A mobile, 500-lb capacity hydraulic telescopic lift designed for interior or exterior repair, maintenance and construction, called "Ski-Ride". It is manufactured by Allied Mfg. & Sales Co., Chicago, Ill. . . . (31) The addition of two new community TV antenna system cables to its line has been announced by Belden Manufacturing Co., Chicago, Ill.

(32) Three new "Antenaplex" broadband amplifiers, developed by the Radio Corporation of America, Camden, N. J., for amplification of different combinations of VHF television channels to provide greater economy and flexibility in master-antenna TV systems. . . . (33) A portable instrument, Model 555 Centi-Low ohmmeter, capable of measuring extremely small values of resistance has been announced by the Chicago Industrial Instrument Co., Chicago, Ill. . . . (34) A new tool for joining the smaller sizes of single core aluminum conductor steel reinforced (ACSR), has been developed by the Aluminum Com-pany of America, Pittsburgh, Pa.

(35) Clark Industries, Portland Ore., has announced a new hand tool which drives "nails" into concrete with a hammer, called the Omark hammerdrive hand-fastening tool. . . . (36) Aquatherm, a special heat, dampness and moisture-resistant wire (RHW Underwriters' approved) has been perfected by Circle Wire & Cable Corp., Maspeth, L. I., N. Y. . . . (37) Easy-towing, one-man loading trailers designed for transporting and dispensing large reels of electric cable are being offered by Utility Equipment, Inc., Buffalo, N. Y.

(38) New lightweight "Baby Ditch-Witch" trenching machine, ideal for cutting narrow trenches for burying lighting circuits, has been announced by the Charles Machine Works, Perry. Okla. . . (39) General Electric Co., Lynn, Mass., has announced a new aircooled germanium plating rectifier. ... (40) Three high-power, low-band mobile FM radio systems, including the first RCA 100-watt 2-way radio equipment were announced recently by the Radio Corporation of America, Camden, N. J.

(41) Slim lines, polished brass, and a corded rope effect combine to give a new group of lighting fixtures a "Casual Look". They are known as the "Cordette Casuals" and are manufactured by Moe Lighting, Chicago, Ill. ... (42) Six new kits for on-the-spot modification of G-E magnetic starters are now available from the General Electric Co., Schenectady, N. Y. . . .

(43) Electro Products Laboratories, Chicago, Ill., has introduced the new 4950 series of high-frequency carrieroperated proximity transducer sys-

CATALOGS and BULLETINS

(44) PIPE THREADER AND DRIVE are detailed in Form PM-656 which covers construction features of both tools, performance benefits and capacities. Beaver Pipe Tools, Inc

Bulletins GEC-(45) MOTORS. 1026A and GEC-1027A, each 11 pages, give buying information on fractional and integral hp motors for single- or polyphase operation. Basic data on these induction motors includes dimensions, ratings and applications. General Electric Co.

(46) WIRING DEVICES, 1400 items are illustrated and described in new 72-page catalog. New line of locking and "U" grounding devices are featured along with a line of 20amp armored and rubber caps and receptacles. Eagle Electric Mfg. Co., Inc.

(47) TRANSFORMER designed for pole or wall mounting can boost or buck secondary voltage 5 percent on 240/120-volt circuits, adjust distribution transformer ratios, and reduce flicker in long secondary runs. The compact Handi-Auto transformer is available in thru ratings up to 37½ kva. Bulletin 61B8490, 4 pages. Allis-Chalmers

(48) LUMINAIRES of the Mohawk line are designed for surface mounting on low ceilinged installations. Units are available with four styles of shielding in 4- or 8foot lengths. 6 page brochure. Sylvania Electric Products Inc.

(49) TUBING SUPPORT SYSTEM features adjustable and extension elements that eliminate cutting on the job. Bulletin 656-G, 20 pages, gives dimensions and applications of all system components plus critical layout data. P-W industries, Inc.

(50) PLASTIC ELECTRICAL TAPES for a variety of splicing and wrapping applications are described in Brochure T-2. Physical and electrical characteristics of these pressure sensitive tapes are listed. Permacel Tape Corp.

(51) RESIDENTIAL LAMPS, including floor, wall, table and ceiling units, are illustrated in a 16-page catalog covering 160 of the most popular lamps. Materials, dimen-



CAPS

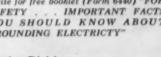
Featuring the Arrow-Hart Rubber Rim that means greater insulation, better finger grip!



This Rubber Rim Is An Arrow-Hart Exclusive! CAT. NO. 7264

Receptacles and Grounding Caps are listed as standard by Underwriters' Laboratories.

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Wiring Device Division THE ARROW-HART & HEGEMAN ELECTRIC CO.

103 Hawthorn Street, Hartford 6, Connecticut Offices and Sales Engineers in Principal Cities

Quality wining devices · motor controls · enclosed switches · appliance switches

COMPARE . . . QUALITY, PRICE EASE OF INSTALLATION

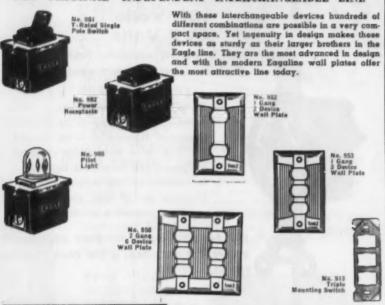
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INTERCHANGE LINE

INTERCHANGEABLE WITH ALL STANDARD LINES OF WIRING DEVICES

THE ORIGINAL INDEPENDENT INTERCHANGEABLE LINE



Also Available: Nite Lite, Pilot Light Receptacle, Neon Pilot Light, Push Button, Blank Insert, Flat Plug Caps and a complete line of Switches.

Check These Features

- All devices interchangeable with all standard wiring devices.
- All devices are of bakelite totally enclosed mechanisms.
- All switches and receptacles have double wipe phospher bronze contacts.
- Large head binding screws, ample for #10 wire.
 Large radius on receptacle contacts permits easy entry of Plug Cap prongs.
- Wall plates carry the distinctive Eagle design.
 Correct mounting strap is packed with each wall plate in individual envelopes.
- All wiring devices are individually boxed and Listed By Underwriters' Laboratories.

WRITE FOR FREE DESCRIPTIVE BROCHURE

SOLD THROUGH WHOLESALERS ONLY





sions and illuminating power of each are given. Lightolier, Inc.

- (52) PIPE PUSHER and optional power unit are the subject of a 16-page manual describing proper use of the equipment for installation of underground rigid or flexible conduit and cable. Mercury Hydraulics, Inc.
- (53) SELENIUM RECTIFIERS in ratings of \$\frac{1}{2}\$ to 125 kw may be operated in multiples to 500 kw. Units feature low installation and operating cost, less floor space, and long life. Bulletin GEA-6545, 12 pages gives technical and application data. General Electric Co.
- (54) INCANDESCENT LIGHTING EQUIPMENT for industrial and gym lighting are listed in 52-page catalog 10. Units described include reflectors, high bays, vaportight units and floodlights. Fittings and accessories are also included. Spero Electric Corp.
- (55) PLASTIC-COATED CONDUIT. Installation procedures for obtaining maximum efficiency and protection from coated rigid steel and thinwall conduit are illustrated in 14-page Booklet 18-166. General Electric Co.
- (56) DUAL-PURPOSE FIXTURE. Unique new unit, designated the Multi-Vent Trofferlite, combines the functions of illumination and air diffusion. Diffuser chamber in body of troffer unit is connected to air duct by flexible tubing. 8-page bulletin gives design and performance data. Benjamin Electric Mfg. Co.
- (57) FHP Motors of dc shunt, dc permanent magnet, and universal types are detailed in a 16-page catalog along with speed reduction units of open or closed styles with single or double reduction. Rae Motor Corp.
- (58) BATTERIES for stationary power services feature Plante-type plates which afford reserve supply of lead and working area more than five times the plane surface of the plate. Form 5916, 6 pages, illustrates design and performance benefits of Exide-Manchex batteries. Exide Industrial Div.
- (59) THRUST MECHANISMS delivering straight-line thrusts from 50 to 800 pounds are detailed in 8-page Bulletin GEA-1614D. Thrustor units include integrated electric motor for low cost operation and simplified control. General Electric Co.

CENTURY HAS THE COMPLETE LINE ...

g as 400 H.P.

small as 1/20 H. P.



WHATEVER YOUR APPLICATION THERE'S A



125 H.P. Type SC



Performance-Rated to do the job

You'll get the top performance your equipment's designed for . . because there's a motor designed for it in the Performance-Rated Century line.

Century's technique of Performance-Rating enables you to choose motors with the right size, speed, frame, and torque characteristics to fit-exactly-your application requirements.

You can select from a range of 400 to 1/20 h.p.; AC single or polyphase, or DC; drip proof, dust proof, or explosion proof frames. There are optional corrosion-resistant features; constant speed, multispeed, varying or geared speeds.

Let us prove the value of Performance-Rating for you... without obligation. Call or write your nearby Century District Sales Office or Authorized Distributor.

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ELECTRICAL CONSTRUCTION AND MAINTENANCE . . . OCTOBER, 1956

Advance Transformer Offers World's Most Complete Line of Quality Fluorescent Lamp Ballasts

Through outstanding engineering developments and modern manufacturing facilities, ADVANCE TRANSFORMER COMPANY has become the world's largest manufacturer devoted exclusively to the production of quality fluorescent lamp ballasts. These precision built, power regulating instruments supply exacting amounts of electrical energy for the efficient operation of all fluorescent lamps and are apity called "THE HEART OF THE LIGHTING INDUSTRY."

Continuing research and constant new developments in both engineering and manufacturing divisions have made possible the introduction of many new ballasts with exclusive patented features. Thus, ADVANCE provides lighting equipment manufacturers, designers, architects, engineers, contractors and other fluorescent lamp ballast users the world's most extensive line of fluorescent lamp ballasts. When you use ADVANCE, there is a ballast for every specific purpose, never a need to compromise.

ADVANCE ballasts are listed by Underwriters' Laboratories, Inc., meet the Canadian Standards Association requirements and many meet or exceed Certified Ballast Manufacturers' specifications. Specify ADVANCE to be sure to get the ballasts with the "plus factors" that have built the world's largest company devoted exclusively to the manufacture of fluorescent lamp ballasts.

The Advance Transformer Company will replace, at no charge, any ADVANCE fluorescent lamp ballast which becomes inoperative within two years from date of manufacture, provided the conditions of ballast operation have conformed to the company's recommendations and the inoperative ballast is returned to an authorized ADVANCE Service-Stocking Distributor.

For anyone who manufactures, specifies, installs or uses fluorescent lighting. AD-VANCE TRANSFORMER COMPANY has prepared helpful literature which they will gladly send without cost or obligation.

Fluorescent Lamp Ballast Buyer's Guide

This eight-page brochure gives data on the world's most complete line of Fluorescent Lamp Ballasts. It includes specifications, wattage, watt loss, circuit voltage, dimensions, weight, etc. This brochure is an invaluable aid for specifiers and users of fluorescent lamp ballasts.

Fluorescent Lamp Ballast Cross Reference Guide

This helpful guide lists many popular ballasts by catalog number and the ADVANCE ballast that should be used whenever ballast replacement becomes necessary. It is an invaluable reference chart that saves time and money for all users of fluorescent lamp ballasts.

Service-Stocking Distributor Plan and List of Distributors

This is a six-page color brochure that lists, by city and state, more than 550 distributors who carry a stock of ADVANCE Fluorescent Lamp Ballasts, to provide immediate replacement service for ballasts of any make that become inoperative.

You may receive a copy of one or all of these brochures by contacting ADVANCE TRANSFORMER COMPANY, Marketing Division, 2950 North Western Avenue, Chicago 18, Illinois.

- (60) FASTENING SYSTEM employs ballistic shaped studs and special holding tool to eliminate drilling or explosive charges. Pins are placed in holding tool and driven into concrete or steel with 2-3 lb. hammer. Pull out resistance up to 1400 lbs. 4-page folder. Hilti Rapid Fastening Systems, Inc.
- (61) OUTDOOR LIGHTING SETS for sealed beam lamp spot or flood-lighting are available in single or cluster units with integral cord. Sets come with colored lens for holiday decorating with light. Bulletin 1040-56, 2 pages. Steber Mfg. Co.
- (62) Motors of the repulsion-induction (buried bar) type are produced in ratings from 4 to 7½ hp in drip-proof, splash-proof, and totally enclosed models. Design affords smooth transition from repulsion to induction and no-load characteristics approximately 5% above synchronous level. Engineering Data Bulletin SDA-163-A. Peerless Electric Co.
- (63) MAGNETIC STARTER KITS for modifying G-E controllers to fit special conditions. Bulietin GEA-6481, 12 pages, describes addition of push button and selector switch, auxiliary interlock, 3rd overload relay and other features to standard starters. General Electric Co.
- (64) Fractional HP Motors in sizes from 1/20 to 1 hp are detailed in 10-page Bulletin 1-1PI. Characteristics of various types, design improvements, and dimensions are included. Century Electric Co.
- (65) INSULATING MATERIALS of ceramoplastics and glass-bonded mica are described in comprehensive Engineering Data Bulletin. A comparison chart details properties of these materials and other plastic and ceramic insulators. Mycalex Corp. of America.
- (66) DC MOTORS in ratings from through 200 hp and motor-generator sets up through 200 kw are described in 6-page Bulletin 53B8424. Cutaway views of motor show construction features. Characteristics and applications of four types of dc motors are discussed. Allis-Chalmers Mfg. Co.
- (67) CORDS for communication and power connections extend to approximately six times their retracted length. Catalog 556, 12 pages, lists the complete line. Koiled Kords, Inc.

- (68) POLYETHYLENE TAPE rendered non-melting by electron bombardment offers high temperature stability plus excellent electrical and mechanical properties of conventional polyethylene. Brochure CCD-1 covers uses and characteristics of Irrathene as a motor insulation. General Electric Co.
- (69) TRANSFORMERS for a wide range of applications are discussed in an 8-page folder covering construction, accessories and maintenance procedures. Electric Service Co.
- (70) SHOPPING CENTER DESIGN booklet B-6569, 32 pages, describes uses of various electrical equipment in modern shopping centers. Westinghouse Electric Corp.
- (71) MOTOR STARTER. Folder EE-191, 4 pages, describes the new features incorporated into the Bulletin 9586 ac magnetic starter. Among these are improved pressure type terminals, snap-on contact block cover, alarm circuit and four position overload relays. Cutler-Hammer Inc.
- (72) GARDEN LIGHTING, including both permanent and portable units, is concisely cataloged in bulletin 135-56, 4 pages. Construction, dimensions and list prices are given. Steber Mfg. Co.
- (73) DIFFUSER for fluorescent panels is named No. 83 Crysta-lite, composed of prismatic fluted glass and recommended for large area general lighting. Folder L-110-C, 6 pages, gives photometric data and technical description. Corning Glass Works.
- (74) MOTOR TERMINAL BOXES. Bulletin MA2, 8 pages, covers line of four sizes with all required data for selection and ordering. Gaskets are also listed. Kolton Electric Mfg. Co.
- (75) GROUNDING of portable equipment is discussed in 12-page booklet on current N.E. Code requirements, techniques, and available devices for this important function. Arrow-Hart & Hegeman Electric Co.
- (76) CABLE TROUGH. Design data and system components of the 70,000 series are presented in 12-page bulletin 67A. Applications, dimensions and components of the Rakit system of supporting structures for raceways are covered in 8-page catalog 853. T. J. Cope, Inc.



GARGY Speed-Line

LABOR SAVING

on continuous-row lighting installation

WINS CONTRACT

for Electric Service Co., Eau Claire, Wis.



12:53 PM—Everything ready to begin installa-tion in this typical Eau Claire classroom: Hickeys, to take Garcy Adjustable Stem Hangers, have been previously attached to ceiling. Garcy Speed-line Visualier bulk-packed fixtures have not yet been removed from cartons.



1:00 PM-Wireway channels have been unpacked and laid out along sawhorses. Wireway covers have been removed and Speed-line couplings, inserted between fixtures, are being fastened in place. The four individual fixture wireways now make a rigid continuous 28-foot assembly.



INSTALLED CLASSROOM LIGHTING



1:20 PM-The first row has been leveled and lamped, and the workman is attaching the last of the separate louver shields. Meanwhile the other two workmen have been repeating the wireway assembly procedure for the second row.



1:32 PM—The second lamp row has been assembled and installed . . , just 12 minutes after completion of the first row.

Estimating that \$4,482 could be saved by using the Garcy Speed-line System instead of separate external mounting channels, Electric Service Co. submitted the winning bid for relighting the Eau Claire Senior High, School.

The potential savings of the Speed-line System were well known to E. F. Klingler & Associates, architects, who supervised the job of relighting and rewiring 22 standard classrooms, about 750 feet of corridor, plus storage space, toilets, etc. The architects invited all bidders to submit an alternate figure based on Speed-line savings. In their successful bid, Electric Service Co. figured that Speed-line would save more than 50% of installation labor costs. Their faith in Speed-line was amply justified . . . as indicated by the remarkable series of progress photographs pictured here.

Learn how Speed-line can cut installation labor costs 50% and more on continuous-row lighting

Send today for Bulletin 551-L

GARCY

Quality by Design

GARDEN CITY PLATING & MFG. CO., 1730 N. Ashland Ave., Chicago 22, III.
in Canada: Garcy Co. of Canada, Ltd., 1244 Dufferin St., Toronto 4



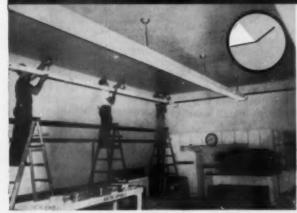
1:08 PM—Wiring connections have been completed, wireway covers have been replaced . . . all this at convenient working level, not perched on top of ladder. Garcy Adjustable Stem Hangers have been clamped to assembly. Hanger canopies have been placed over stems.



1:09 PM—In one minute's time the rigid 28foot assembly has been carried up the ladders, and stem hangers hooked into ceiling hickeys. No lock nuts, no washers are needed.



BY 3 MEN IN LESS THAN 1 HOUR



1143 PM—Wireway for the third and last row is carried to the ceiling.



1:51 PM—All three rows installed, lamped and lighted. Elapsed time, 58 minutes. Saving in labor costs permits budget-wise use of Garcy Visualier, finest in school and office lighting.

BULLDOG Electrostrip



Products Co., Detroit 32, Michigan. @ BEFCO

IF IT'S NEW... IF IT'S DIFFERENT... IF IT'S SETTER... IT'S BULLDOG

ELECTRIC PRODUCTS COMPANY

A Division of I-T-E Circuit Breaker Company



Export Division: 13 East 40th Street, New York 16, N.Y. . In Canada: BuilDog Electric Products Co. (Canada) Ltd., 80 Clayson Road, Toronto 15, Ont.

Reader's Quiz

QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repair. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published we pay \$5.00.

Rewinding Motor 3- To 1-Phase

QUESTION T30—Recently I was asked to change a 220-volt, 3-phase, 1-hp motor to 220-volt, single phase. I have tried most everything, changing the coils so they are north and south, leaving some out, etc.

Is it possible to use a capacitor by using some coils as starting coils or could I rewind the motor as regular single-phase coils and startwinding but with a manual switch?

—R.W.D.

ANSWER TO T30—Place one of the 3-phase wires in series with a motor starting relay and an electrolytic capacitor. This system is used on refrigeration devices. The motor size will be reduced. Devices are available to convert single-phase to 3-phase, but it might be cheaper to buy a new single phase motor.—

ANSWER TO T30—Assuming that it is desirable to change over the motor rather than buy a new one, and assuming that you can accept a less powerful motor or one that can operate only intermittently, then the easiest solution is probably as follows: disconnect one phase winding completely. Connect a capacitor in series with a switch and both of these in series with one of the remaining phase windings. This can then operate as a capacitor-start single-phase motor.

The capacity of the capacitor should be increased gradually, from about 80 MFD, until sufficient starting torque is obtained. Check the voltage across the capacitor to be sure the rated voltage is not exceeded. It may be necessary to use a transformer, reactance, or resistance to lower the line voltage. This is likely to be the case if the existing winding is wye rather than delta.—R.J.S.

ANSWER TO T30—It is possible to rearrange the coil connections to derive single-phase action from the motor, provided the coils are arranged to provide for a main winding and an auxiliary winding or separate starting winding displaced 90° from the main winding. This is then essentially a resistance

split-phase motor. One point to consider, however, is that the auxiliary winding must have a greater resistance to reactance ratio than the main winding. This auxiliary winding must be opened as the motor approaches full speed. This can be done by incorporating a centrifugal switch or an external electromagnetic relay. Should the angle of difference between windings need be adjusted, a capacitor can be used in series with the auxiliary winding. By the addition of this capacitor the auxiliary winding can be reduced and still provide adequate starting torque.

The motor can also be rewound as you wish but again observing certain precautions such as winding displacement, resistance to reactance ratio, correct value of capacitor if used, and a definite means for opening the auxiliary winding automatically. In this case the electromagnetic relay would suffice.—

J.R.K.

Duty-Ratings of Safety Switches

QUESTION U30—In our plant we many times experienced the difficulty of fused safety switches heating at the various joints within the switch. One engineer said, "If you would go to a heavy duty safety switch, you would no longer have this difficulty." Another engineer said, "This would not help because the only difference between the standard and heavy duty switch is the case and locking mechanism." Which engineer was right?—M.D.

ANSWER TO U30—I cannot agree with the engineer that told you the only difference between the standard and heavy-duty safety switch was the case and locking mechanism. This is not so today.

Not too long ago standards were a bit loose on such specifications and some manufacturers put an interlock on a type C switch and sold it for a type A switch. Such practice necessitated switch manufacturers to become more rigid on their specifications.

Today both the standard-duty and heavy-duty switches have locking mechanisms and are rated in horsepower. There is a difference, however, in that the standard-duty meets NEMA specs for type S switches and the heavy-duty meets NEMA specs for type H switches.

The case, the blades, the mechanism, etc., for the heavy-duty switch is heavier in construction throughout.—E.M.

ANSWER TO U30-I don't believe either is right. I think that the operating mechanism is the difference. Just look at your cost and the internal construction of Type "A" over Type "D", size for size. The locking mechanism is better on the "A" but so is the operating mechanism. You will still be using the "A", when you replace the "D", on the same type of operation. You cannot operate a switch at rated load continuously; it cannot dissipate the heat generated by the load. If your connected load is much over 80% of switch rating, normal conditions, you are in for heat trouble, hence, fuse trouble. A maintenance program on switches will help. You will be better off in the long run to make it policy to install next larger size switch to eliminate any heating problems.-W.J.F.

ANSWER TO U30-In experiencing the heating effect at various joints within the switch, several factors must first be considered. Does the applied load exceed the maximum rating of the switch and by how much? Then there is the subject of contact resistance in the switch. Perhaps the knife blades are burned, pitted, corroded or loose in the jaws, in which case this must be remedied. The fuse holders of the fused safety switch may have high contact resistance, thus generating a considerable amount of heat. This condition can be remedied by cleaning and then using fuse holder clamps, which are readily available. Should the load be extremely high, provisions must be made for splitting this load between other switches to observe the maximum allowable limits of the switches.

Various types of heavy duty switches are available—not only in the case and locking mechanism but in the blades, jaws and terminal connections. Oftentimes the ter-



Jersey Central Power & Light Co., South Amboy, N. J. Burns & Roe, Engineers. The Cope Cable Trough shown above carries as much cable as all of adjacent system.

Jersey Central Power & Light Company Cuts Costs with Cable Trough

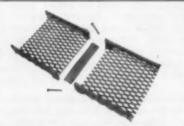
The great space saving possible with Cope Trough is dramatically illustrated at Jersey Central Power & Light Company's South Amboy installation of cable supports. Where space is at a premium, specify Cope Cable Trough.

SAVE LABOR during installation. Cope Cable Trough with the exclusive Pin-Type Coupler goes in faster than any other trough system. Standard fittings are available for virtually any connection, corner, awkward space—yet fewer individual pieces are needed and installation time is greatly reduced.

SAVE MATERIALS with Cope Cable Trough. You support far more cable with the same weight of Trough than with any competing system—and steel is costly.

EXCLUSIVE COPE PIN-TYPE COU-

PLER greatly simplifies installations, reduces installation costs, and provides greater adaptability. Pin is driven into interlocking barrels and rigidly secures the connections. Bottom plate protects cable at Trough connections.



Our engineers are ready to work with you. Write us today for full details on new 70,000 Series.

T. J. COPE, INC

COLLEGEVILLE 5, PENNSYLVANIA













minal connections are silver plated to reduce high contact resistance. Then again, the jaws and blades can be made with silver inlays to reduce this generated heat. So it is definitely not just a difference in the locking mechanism and case, as these parts do not carry current to generate the heat. In examining a particular switch to satisfy yourself, all current carrying components must be examined for this generated heat to observe any burns, dirt, defects or loose connections.—J.B.K.

Hot and Cold F-Lamp Cathodes

QUESTION V30—Referring to hot and cold cathode as applied to flourescent lamps, I have heard it stated that a cold cathode actually dissipates more heat than a hot cathode. If this is so, the nomenclature hot and cold cathode is misleading. Can someone explain?—R.E.B.

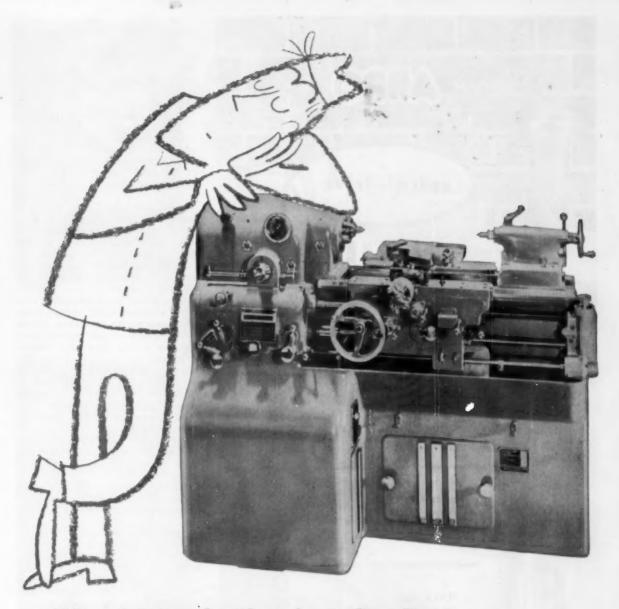
ANSWER TO V30—As I understand it, cold cathode originally received its name because the lamp started cold without any preheating of the electrode.

The bulb temperature of a cold cathode lamp averages 12°F above ambient, whereas the bulb temperature of a 430 ma fluorescent lamp averages about 35°F above ambient, so that the cold cathode lamp is cooler.

There have been statements that a cold cathode lamp is hotter. This impression is obtained because the electrode is so close to the glass that very much of the heat from the electrode passes through the glass, and at this point it is hotter than the glass near the electrode of the fluorescent lamp. This is true because the electrode is further away from the glass of the fluorescent lamp. However, the operating temperature of the electrode of the cold cathode lamp runs approximately 130°C, whereas the temperature of the filament electrode in the fluorescent lamp operapproximately W.M.W.

ANSWER TO V30—The cold cathode is called voltaic emission because high voltage is used to drive the electrons. The cathode temperature is about 150°C. The voltage drop is high with this system—about 100 to 200 volts, thereby causing the glass to heat up.

The hot cathode is called ther-



Why risk production downtime? Keep it going with circuit breaker protection



Type "ETI" F frame breaker

Keeping a machine and its operator idle while locating and replacing a blown element costs industry countless thousands of dollars each year. There's no need for such waste. Replacing outmoded protective devices with I-T-E circuit breakers can cut this loss materially. Then when overloads or short circuits occur, there'll be no waiting, no costly machine downtime, no production bottlenecks, no replacement of parts. The tripped breaker is easily spotted and can be reset as soon as the fault is cleared.

Investigate the economy of circuit breaker protection. See your local I-T-E distributor today. Or write Small Air Circuit Breaker Division, I-T-E Circuit Breaker Company, 19th & Hamilton Sts., Phila. 30, Pa.



I-T-E CIRCUIT BREAKER COMPANY . Small Air Circuit Breaker Division



mionic emission. The electrons are more freely emitted by preheating; the cathode temperature is about 900°C. The voltage used is loweither 120 or 220 volts. The glass is cold because the voltage drop is about 12 to 18 volts.

Because of the high voltage drop at the cold cathode and less at the hot cathode, there will be more voltage dissipation and consequently more heat created at the terminals of the cold cathode than at hot cathode.—P.J.L.

ANSWER TO V30—The term hot and cold cathode as applied to bulb temperature of fluorescent lamps is misleading and incorrect. However, if the terms are applied to the temperature of the electronemitting electrode or cathode, as the terms indicate, they are correct.

Fluorescent lamps operate by virtue of electrons being emitted from electrodes within the lamp. These electrons are actually minute particles of matter that must receive additional energy to overcome the atomic forces holding it within the structure of the cathode material.

One way in which this energy may be provided is by increasing the temperature of the material, which constitutes an addition of energy. This added energy enables the surface electrons to leave the material and is termed "thermionic emission".

Another means of adding energy is to apply an electric potential which will overcome the electric field within the atom; this is termed "field-emission".

The cold-cathode lamp operates by virtue of the field emission principle, which requires a higher voltage at the cathode. For a given current, this means a higher voltage drop and a higher wattage loss with a resultant bulb temperature at this point higher than the same bulb area for the hot-cathode lamp. The electrode of the cold-cathode lamp employs a large area emitting surface compared to the hotcathode lamp with a resultant lower current density and greater heat dissipating area, which enables the cathode to operate at a lower temperature.

The filament of the hot-cathode lamp is heated to a point which permits thermionic emission. Though it may be started cold-cathode, the normal current through the smaller cathode maintains a high temperature at the cathode but with a relatively low voltage drop and low wattage or heat loss.

The cold-cathode lamp is less efficient but has a longer life.—T.J.S.

BRIGHTEN DARK CORNERS AND NEAR-WALL AREAS WITH



GUTH BRACKETS (YOU NAME IT ... WE MAKE IT!)

APPLICATIONS GALORE!

... in barber shops; fitting rooms; over hospital beds, chalk boards, mirrors; for desks near walls, along ceiling beams . . . and many other spots that are difficult to light efficiently with conventional fixtures.



NAME IN LIGHTING SINCE 1902



* Trademark Registered



Can You ANSWER These QUESTIONS?

QUESTION D31—The activity at which I work recently had one of the phases of an 11,000-volt primary open due to a cable failure. Before our main substation could be unlocked and the 11,000- to 4160-volt transformer be tripped out, we had a 20-hp, 220-volt, 3-phase motor single phase and burn up. The heaters in the motor controller were of the specified size for the 20-hp motor.

What can be applied to the 11,000-volt primary to open the other two phases when one phase is opened as in the above case? If there is such a device, how is it applied?—

W.T.E.

QUESTION E31—A one-hp, single phase, 220-volt, Lancaster submersible pump pumps water to a 1000 gallon storage tank about 2500 ft from the pump and about 75 ft higher than the pump house. At the present time, the pressure control at the tank, set for 60 lbs pressure, controls the magnetic starter at the pump house. This requires 5000 ft of outside wiring from tree to tree, which due to storms and other element hazards causes this line to be torn down a few times each year.

Can a pressure control be put at the pump to control it and still allow 60 lbs of water to be pumped to storage tank and eliminate outside wiring?—D.W.

QUESTION F31—Can a standard nine-lead 440-volt delta-connected squirrel cage motor be hooked up in such a way that it will run at half speed at 50% of its rated horsepower? What would the efficiency and power factor be at half speed?—M.D.

QUESTION G31—Recently I connected 3-phase, 240-volt motors with the terms constant torque and variable torque marked on the 2-speed drum switches used.

The machinist in charge of the job told me they also have constant horsepower motors. Will you please explain the terms and also some application for their use.—V.S.

PLEASE SEND IN
YOUR ANSWERS BY NOVEMBER 15

FOR SUPERIOR INSULATION AND JACKETING CHOOSE ALATHON® POLYETHYLENE RESIN

The unique properties of ALATHON polyethylene resins make them suitable for both jacketing and insulating applications. Jacketing of black Alathon withstands conditions of heat, moisture, and weather extremes - assures years of trouble-free service. Alathon absorbs the shocks of rough handling and thereby speeds installation.

The electrical properties of Alathon polyethylene resins are excellent. Their low power factor and dielectric constant remain essentially unchanged over a wide range of frequencies and temperatures. Their moisture resistance and lightness of weight make them eminently suitable for insulating applications.

A complete family of Alathon polyethylene resin compositions is offered by the Du Pont Polychemicals Department. For the compound best suited to your particular use, send for complete details by mailing the coupon below.



There is a difference in polyethylenes-



BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

E. I. du Pont de Nemours & Co. (Inc.) Polychemicals Department

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Please send me complete information on Du Pont "Alathon" polyethylene resins. I am interested in evaluating these materials for

Name.

Position.

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Type of Business.

ELECTRICAL CONSTRUCTION AND MAINTENANCE . . . OCTOBER, 1956

A HAT THAT'S TOO BIG!



SO WHY BUY A Control THAT'S THE WRONG SIZE?

FURNAS

MAGNETIC CONTROLS

GIVE YOU

CORRECT

FOR

THE JOB!

The many in-between sizes in the Furnas Electric starter line let you select the motor control that is best suited for your particular requirements—with no wasted capacity and expense. By matching the starter to the job you can save up to 25%. For proof, we invite your comparison of the Furnas Electric line of starters consisting of 9 sizes with the 5 sizes normally offered.

And you can save up to 40% in space by securing the correct size starters for the job, Furnas Electric produces more stock sizes of starters in the 1-100 hp range than other control manufacturers.



SERIES YD



SERIES YE



SERIES YF

FURNAS

URNAS ELECTRIC COMPANY

WRITE FOR BULLETIN 5530-1067 McKEE STREET, BATAVIA, ILLINOIS

WHAT'S THE LAW?

By JACK and MICHAEL STRAUSS

QUESTION:

Can an electrical subcontractor be denied the right to assign monies due him under a contract?

Midway through a job, Jones, a sub-contractor, began wallowing in financial difficulties. Having run into debt, he began bumping into creditors in all directions.

To alleviate the situation, the harrassed sub-contractor transferred, by assignment, all monies due and to become due to him under his contract with Smyth, the general contractor, to Collins. In turn, the latter agreed to give Jones the financial assistance needed.

Several months later, after the sub-contractor had completed his work in a satisfactory manner, Collins presented Jones' assignment to Smyth but, the general contractor refused to acknowledge it. Instead, he pulled out his contract with Jones and pointed to a clause that read:

"Any assignment of this contract by the sub-contractor, or any interest therein, or of any money due or to become due by reason of the terms hereof, without the written consent of the contractor, shall be void."

"I never gave my consent to the assignment," Smyth added. "It's not worth the paper its written on."

Whereupon, the enraged Collins took the matter to court.

"That clause in the contract is illegal," he told the judge. "It's against public policy. Once a man has earned money, he can't be deprived of his right to do with it as he chooses."

THIS WAS THE DECISION: The Court held for the general contractor. It said while courts have striven to uphold a man's right to assign, they have not failed to recognize the concept of freedom to contract. Therefore, as in this case, where the language of the contract is plain and clear, assignments of monies due under it may be prohibited.

(Based upon a 1952 New York Court of Appeals Decision. State laws vary. For personal guidance, see your local attorney.)



FEEDING anode on Anaconda Type CP Cable into manhole to protect lead-covered cable.

Why let corrosion steal your investment in metals — when protection costs so little

Although many people are unaware of it, corrosion of buried metals is caused by tiny stray electric currents that flow from the metal into surrounding soil or water, carrying particles of the metal with them. Corrosion can be checked by applying direct current from an outside source; the metal surface becomes negative to the surrounding soil or water and stops the flow of current from the metal.

This is called Cathodic Protection-

which eliminates corrosion of metalcovered cable, pipelines, storage tanks, water tanks, ships' hulls and other buried or submerged metal products.

To perform this job, Anaconda has developed a special Type CP Cable. Jacket of polyethylene and DENSHEATH® (PVC) insulation offer top resistance to moisture and soil acids . . . double protection affords longer cable life. Anaconda also offers a special one-layer insulation and jacket

construction of polyethylene for special applications.

For more information on how Cathodic Protection checks corrosion, and detailed information on Anaconda Type CP Cable, write for Bulletin DM-5450. Also, use Anaconda DURASHEATH® neoprene-jacketed cable for buried or aerial distribution lines feeding power to CP systems. Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y.

*Reg. U. S. Pat. Off.

SASSAGE.

SEE THE MAN FROM ANACONDA FOR CATHODIC PROTECTION CABLE

Unfailing Safety

Hazardous Locations
Specify

R&S

Explosion-Proof
LIGHTING FIXTURES

- **V** Outstanding Design Simplicity
- Easy Wattage Conversions and Relamping
- **✓** Superior Lighting Efficiency
- **V** Rugged, Trouble-Free Components

Russell & Stoll fixtures are truly explosion-proof, with walls of high-strength aluminum allay; with lamp and wiring components separate and individually explosion-proof. Assemblies are full-threaded, with precision-machined, flame-light joints to render internal explosions harmless. Note the important combination of advantages listed here—every one is a sound reason why R & 5 fixtures are the outstanding choice of big potroleum, chemical, utility and industrial firms.

R & S fixtures...in pendent, ceiling, bracket types... from 100 through 500 watt sizes.



With 30" Angle Reflector

Ceiling Type Without Reflector





With Standard Dome



replacement lamp bulbs now available. (Information on request.)

3. Globes are impact and explosion-resisting glass.

1. All medium base fixtures from

- 4. Internal Sealing. No external seals required.
- 5. Globe and ring factory assembled; always removed as a single unit. Critical glass and metal flange surfaces never exposed to accidental chipping or damage during relamping. (Globe can be removed from ring assembly if desired, without special tools.)
- 6. High strength, cast aluminum alloy throughout.

- 7. Available in three styles: Type ELP for Pendent mounting, Type ELJ for Ceiling mounting, and Type ELB for Wall mounting.
- 8. Greater light output proved by candlepower distribution tests on every wattage.
- 9. Detachable, interchangeable porcelain enameled steel Reflectors in three styles: Standard Dome, Shallow Dome, and 30° Angle.
- 10. Lamp and wiring compartments are separate, individually explosion-proof.
- 11. Standard Guards are steel, cadmium plated. Cast aluminum alloy guards are also available.
- 12. Rugged Functional Design.
- 13. Standardized bases permit interchanging Reflector-Globe assemblies from 100 to 500 Watts without disturbing wiring connections.

Write for Catalog No. 56-4

RUSSELL & STOLL COMPANY, INC. . 125 BARCLAY STREET, NEW YORK 7, N. Y. D-23



RUSSELL & STOLL

PRECISION-BUILT ELECTRICAL EQUIPMENT - SINCE 1902

Questions on the Code

Answered by

B. A. McDONALD, New York Board of Fire Underwriters, Rochester, N. Y.
GLENN ROWELL, Electrical Engineer, Fire Underwriters Inspection Bureau, Minneapolis, Minn.
B. Z. SEGALL, Consulting Electrical Engineer, New Orleans, La.

Control Switch on Saw

Q. We are designing a radial saw intended for the home workshop tool buyer that will be operated by a \(\frac{1}{2}\) hp, 230-volt integral motor. Must the control switch which will be mounted on this saw be of the horsepower rated type?

—A,D.

A The National Electrical Code will permit the use of an ordinary general use switch provided it has twice the ampere rating of the full-load current rating of the motor. This will require a switch rated at 15 amps, as the full-load current rating of a single phase ac motor operating at 230 volts and developing \$\frac{1}{2}\$ hp will be 6.9 amps in the 1956 Edition of the National Electrical Code.—G.R.

Motor Conductor Size

A continuous duty motor is remotely located quite some distance. When determining the feeder conductor size to prevent excessive voltage drop, will a current equal to 125% of motor running current be used in the voltage drop or will the 25% be added after the conductor size is determined by using the running current?—P.L.

The Code requires that the A. motor branch circuit conductors have a minimum size based on 125% of the full-load current rating of the motor. This in itself provides in some measure for excessive voltage drop caused by the starting current of the motor. If in addition we decide to further increase the size of the branch circuit conductors because of the excessive length of the motor circuit, i.e., to compensate for the excessive voltage drop caused by the branch circuit conditions, we do not have to take into account the additional 25% required by the Code since we are going beyond the original 125% size required.

For example, suppose we have a 10-hp, 240-volt, 3-phase, 27-amp, standard squirrel-cage motor and

this is connected to a 300-ft branch circuit run. On the basis of Code requirements the minimum size conductor would be based on 1.25 x 27 or 33.75 amps.

This would require at least a No. 8 Type RH. Because of the extra long circuit run we decide to install three No. 6, Type R. The current capacity is 55 amps and is well above the 125% minimum required by the Code, so it will satisfy both the Code requirement and the need for larger conductors for voltage drop.—B.Z.S.

Service vs Feeder Disconnects

A small outbuilding is to receive a 230/115-volt 3-wire service from an overhead line passing nearby. The building is covered by Section 2351(d) and has the following loads served through a six circuit panelboard:

 $\begin{array}{cccc} Circuit \ Load & Total \ Load \\ 1 & 4-100\text{-}watt \\ & fixed \ lamps \ 400 \ watts \\ 2 & 1-100\text{-}watt \end{array}$

fixed lamp 100 watts
5 — 100-watt
pit lights* 500 watts

 $\begin{array}{ccc} & floodlights \ 1000 \ watts \\ 6 & 4-Receptacles \end{array}$

1½ amps ea 6.0 amps Total: 2000 watts

plus 10.6 amps

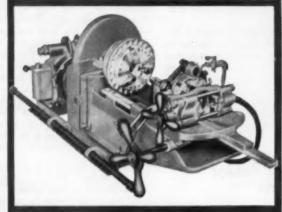
The total actual load would be slightly less than 15 amps with a 230/115-volt 3-wire service (*the pit lights incidently, would be used rarely, although they are included), but to allow for possible future air conditioning, it is intended to install No. 6 service conductors from the No. 2 overhead line. This overhead line also serves other outbuildings and outside lighting.

The problem is, will this meet Code requirements without a main breaker rated at 50 amps? In Section 2371 (a) we are told the service conductor must be fused at its rated capacity except under paragraph 3 not more than six circuit breakers or fuses may serve as the disconnecting and overcurrent device. With 6 15- amp breakers we have evidently protected a No. 6 wire rated at 55 amps for type RW with a 90-amp overcurrent device. In searching the Code I cannot see where this is either allowed or prohibited. In effect, Section 2371 tells me I cannot do this with one main breaker, but if I use six there is no limit on their rating as long as they protect the branch circuits .-D.H.N.

Section 2351-d covers the A. disconnecting means for a building located on a property comprising more than one building under single management. The conductors feeding such a building are not in my opinion service conductors since they are fully protected where the service enters the property at some other building. As a result, such conductors come within the classification of a feeder and they are not subject to the provisions of Section 2357 which requires a minimum 50-amp breaker or a 60-amp switch. The last sentence of Section 2351-d appears to verify this opinion since it recognizes a small snap switch to act as a disconnect for a garage on residential property.

Section 2371-a also applies to unprotected and ungrounded service conductors and not to feeders. I do not believe that the wording of the first paragraph of this Section requires the service conductor to be fused at its rated capacity. The phrase "not higher than the allowable carrying capacity of the conductor" infers that the rating could be less than the rated capacity of the conductors. In accordance with the above concept of these Code provisions, it appears to me that a minimum 50-amp breaker would not be required by the Code. It also follows however since you are planning for future loads by installing No. 6 feeder conductors, that it would be desirable to install the disconnecting means also at this time. This opinion is based on the

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premise that the main service conductors terminate where they enter the first building and the feeder to the other buildings are fully protected.

The question of using more than one means of disconnect for a building served through a master service, as covered by Section 2351-d is not specifically covered in the Code, but I believe that Section 2351-a which recognizes six switches or breakers for the service disconnect, would apply equally to the feeder disconnect under the conditions stated. Any other concept would be inconsistent with present Code provisions.

It is true that the use of multiple service circuit breakers or sets of fuses does not limit the current in the service entrance conductors to a degree that is obtained when one switch or breaker is installed. As you say, the service conductors could be overloaded without any of the six circuit breakers operating. At the present time the Code definitely recognizes this possibility and many inspection authorities do not agree with this concept of protection. They believe that the current to a building should be limited by the use of one circuit breaker or set of fuses. Many other factors however are involved .-

Dry Type Transformer

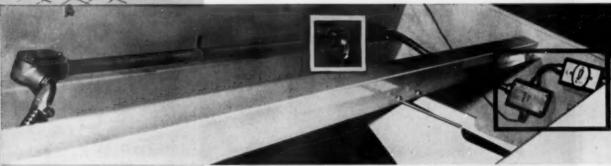
B.A.McD.

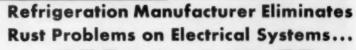
To provide low voltage energy for the control circuit of an electrical motor, I recently mounted a dry type transformer at the end of a wiring gutter under a number of control units. The only conductors that come within 6 in. of this dry type transformer are those connected to the transformer and yet the inspector tells me I must remove this from this wiring trough. Inasmuch as no conductors extend past this unit, it interferes in no way with the wire space within the trough and I am unable to understand why the inspector has ordered it out. Can you advise me if this is a Code requirement? -P. G. R.

Auxiliary gutters used to supplement wiring space at meter centers, distribution centers, switchboards, and similar points of interior wiring systems are designed only for the enclosure of conductors or bus bars and should not be used to enclose any other type of electrical apparatus. The reason for this requirement, which is found under Section 3741 of the

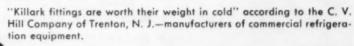


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National Electrical Code, is undoubtedly based on the necessity of keeping unnecessary heat producing apparatus from this enclosure so even though there are no conductors other than those connected to the transformer in question extending anywhere near this unit, the unit will dissipate heat within the enclosure which added to the heat being given off by the conductors contained therein may bring the ambient temperature within this wireway to a point above an acceptable level. The inspector, therefore, is simply following the requirements of the National Electrical Code in requiring the removal of this dry type transformer from this enclosure. _G. R.

Underfloor Raceways— Loop Wiring

In the April 1956 issue of E.C.&M. the N.E.C. official interpretation No. 427 permits the looping of circuit wires from outlets in an underfloor raceway system.

We have been under the impression that wires from "each" outlet had to be run back to the floor junction boxes or to the panels and that looping was prohibited.

Abbott's Electric Code Handbook very clearly prohibits the looping system. Electrical Code Diagrams by B. Z. Segall also shows wires from each outlet run direct to the junction box without other connections or outlets.

Will you please advise us if we are correct in the assumption that the "Loop System" is now approved and that it applies to both underfloor raceways and cellular metal floor raceways.—D.H.D.

A. For the convenience of our readers we are quoting interpretation No. 427 as follows:

"INTERPRETATION No. 427 SECTIONS 3546 and 3547; ABAN-DONED CIRCUITS IN LOOP WIRING; UNDERFLOOR RACE-WAYS:

"Question No. 1—Is it the intent of Section 3546 and 3547 to prohibit the running of the same conductors to the individual outlets in raceways, so-called loop wiring?

"Answer-No.

"Question No. 2—If it is not the intent to prohibit loop wiring, as mentioned in Question 1, is it permissible in the event of discontinuance of one outlet to take the conductors supplying that outlet and

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place them back in the raceway or must these conductors be removed from the raceway and a new set of conductors inserted to supply the other outlets previously connected in the loop?

"Answer—The sections of circuit conductors which become unused when an outlet is abandoned, discontinued, or removed must be removed from the raceway. No spliced or reinsulated conductors may be allowed to remain in the channels or headers of an under-

floor raceway system."

It appears obvious from the above interpretation that the looping of circuit wires from outlet to outlet is definitely recognized in an underfloor raceway system of wiring. While this interpretation applies specifically to Article 354—Underfloor Raceways, it is my opinion, on the basis of hazard, that there is no distinction between such an application when applied to Article 356—Cellular Metal Floor Raceways.

A copy of this correspondence is being forwarded to Mr. W. R. Volheye, Chairman of Panel. No. 8, National Electrical Code Committee, with the request that he rectify any misconcept or verify the opinion expressed.—B.A.McD.

Motor Installation

Q. We are installing four identical motors which are magnetically controlled, each operating an individual machine. May we energize the control circuit through a single transformer?—M.C.

A If the disconnect awitch acts as the disconnect for all four motors, then the transformer supplying the low energy control circuit could be connected to the load terminals of that disconnect switch. But if each motor has its own disconnect means, then the Code would prohibit the use of a single transformer to supply low energy current for the control circuits of the four motors.

Section 4406 reads as follows:
"The disconnecting means shall disconnect both the motor and the controller from all ungrounded supply conductors. The disconnecting means may be in the same enclosure with the controller."

Then under Section 4374 of the Code you will note the following: "Control circuits shall be so arranged that they will be disconnected from all sources of supply

when the disconnecting means specified in Section 4406 is in the open position. The disconnecting means may consist of two separate devices, one of which disconnects the motor and the controller from the source of power supply, and the other, the control circuit from its power supply. If two separate devices are used, they should be located immediately adjacent one to the other. If a transformer or other device is used to obtain a reduced voltage for control circuits. such transformer or other device shall be connected to the load side of the disconnecting means."-G.R.

Grounding Conductor

When a dust-tight fixture in a grain elevator is supplied through a Type S flexible cord, does the Code require the metal exterior of this fixture to be grounded even though the fixture is beyond reach from the floor?—R.M.S.

Yes, the Code under Section A. 5066, paragraph a, provides that the exposed non-current-carrying metal parts of equipment such as the frames or metal exteriors of motors, fixed or portable lamps or appliances, lighting fixtures, cabinets, cases, and conduit, shall be grounded as specified in Article 250 of this Code and inasmuch as the light fixtures in question are supplied through a Type S cord, it would be necessary under section 2557 to provide either a separate grounding conductor or a Type S cord having three conductors with the third conductor used for grounding the fixture.-G.R.

Conductor Overcurrent Protection

O. In the NEC No. 2401 general requirements, overcurrent protection for conductors is provided for the purpose of opening the electric circuit if the current reaches a value which will cause an excessive or dangerous temperature in the conductor or conductor insulation and No. 2403 seems to bear out the same thought implying most strongly that the wire should not be fused above its rated current-carrying capacity. Therefore, a No. O RH conductor rated at 150-amp only is not properly protected if fused at 200-amp. Am I right in this?-E. B. L.

Under the introduction to the Code, we are advised that the first paragraph of an article usually states a fundamental or an objective of safeguarding, and the paragraphs that follow set forth the recognized methods of satisfying the fundamental. I believe this to be the case in connection with Section 2401. Section 2403 sets forth the methods of protecting conductors in line with the intent of the fundamental. The first sentence of this rule states that conductors shall be protected in accordance with their current carrying capacities, as given in Tables 1 and 2 of Chapter 10 with eight exceptions. A review of these exceptions indicate the practical considerations which are involved. As an example of exception (a), standard size fuses would have to be manufactured in sizes within 5 amps of one another if we were able to protect the various conductors covered by Table No. 1 in line with their current carrying capacities. The same reasoning applies to circuit breakers. If there was no exception applicable to fixture wires, as covered by Section 2403-d a No. 18, type PO fixture wire would have to be protected at 5 amps. Exception (e) covers motor branch circuit conductors which in some cases are overfused as much as 300% of conductor ratings obtained from Table No. 1.

If there were no provisions for a 5-ft tap, it would be necessary to either fuse this tap or run the large feeder conductors direct to panels which may be rated in the vicinity of 30 amps. The same reasoning applies to remote control conductors. Several years ago many of these exceptions to the fundamental concept of safety did not exist in the Code and the resulting field experience indicated a need for a thorough re-examination of all of the factors involved. I recall the day when a 3-phase 220-volt induction motor, with a full load current of 15 amps was wired with No. 6 conductors because the starting current of the motor was 45 amps. The Government believed this to be a waste of critical material and ordered the industry to do something about it. I personally believe that the exceptions, over many years of field experience, have proven to be safe within the minimum standards of safety established by the Code.

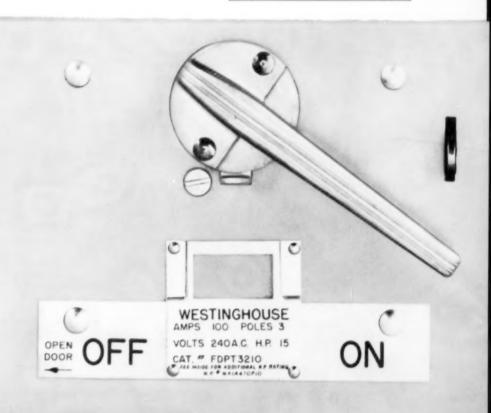
In accordance with the foregoing a No. O RH conductor used as a tap, or for a motor branch circuit could be fused at 200 amps, and possibly more. Insofar as the Code

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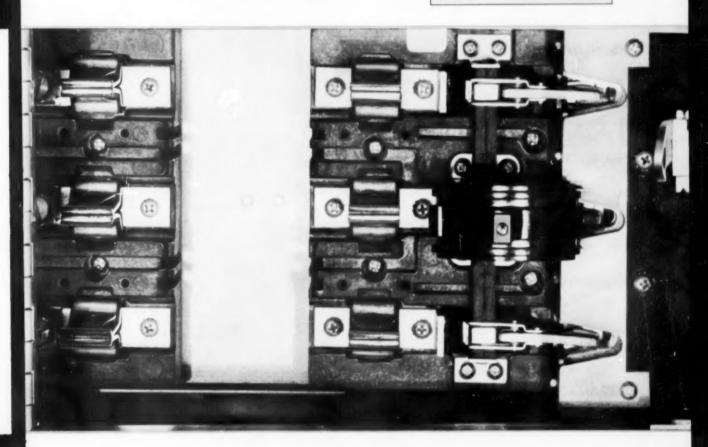
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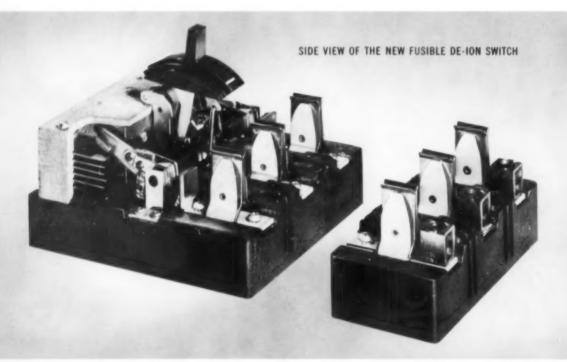
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is concerned, such protection is fully recognized and the conductor is properly protected. This is in line with the degree of safety established by the Code and if field experience indicates that the degrees should be raised, I suspect that such action would be taken.

—R. A. McD.

Disconnecting Means

May we use a circuit breaker contained within a panel the cover of which may be locked in the closed position as a disconnect for a motor located at some distance and beyond sight of this breaker panel?—D.E.L.

If this breaker panel you mention consists of a number of breakers supplying more than the circuit to the motor in question, the breaker could not be considered as the disconnect for the motor inasmuch as it would be necessary to lock more than the single circuit. If, on the other hand, the breaker was contained within a cabinet of its own, the locking of the cover would make it impossible to energize the circuit should the cover be locked while the breaker is in the off position and it could then be considered as the disconnecting means for the motor supplied by that circuit.-G.R.

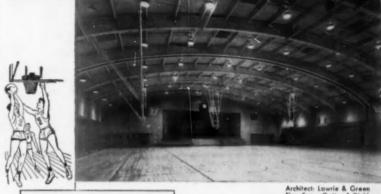
Multiple Services— One Building

Code Section 2321 is clear with regard to services originating from the same transformer bank or secondary. However, is it the intent of the Code to permit an unlimited number of services of the same characteristics provided they originate from separate transformer banks? This question is of considerable interest, since many military construction projects consist of additions to existing buildings. It is the practice of some engineers to provide a new transformer bank and new service for each addition, thus resulting in as many as three or four 120/208volt, 3-phase, 4-wire services to a single building. Your interpretation will be appreciated .- R.J.R.

A. In applying the N. E. Code
provisions of Section 2321,
we should remember that this section covers exceptions to the funda-

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mental rule covered by Section 2301 which limits, in general, a single set of service conductors to a building. It therefore follows when applying the provisions of Section 2321 that the importance of the fundamental should not be discounted in favor of the exception. The exceptions were established to take care of special applications or conditions and should be treated accordingly.

In the case in question, which concerns additions to existing buildings, it appears to me that a new set of service conductors would be permitted to serve the new addition provided the two following conditions exist:

1. Section 2321-c. Capacity requirements.

2. Section 2321-d. Building of

I am not considering the other exceptions since they do not appear to be concerned. Another factor however which enters the picture concerns the definition of a building. Is the new addition cut off from the existing building by an unpierced fire wall as covered by the Code definition of a building? If it is, there is no question with respect to the installation of the new service. If it is not so cut off there is a question which may be answered in the affirmative when one of the following conditions exist.

Section 2321. Capacity Requirements. Since the Code does not cover the many variables which may be considered under this exception it is obvious that various interpretations will result. What "Capacity Requireconstitutes ments" in terms of kva? Does it concern the building load or does it also concern the outdoor distribution system? Personally, I am inclined to believe that an existing service of 2000 amps which is insufficient to accommodate the load requirements of the new addition would warrant the installation of a new service. Possibly this value could be lowered to the vicinity of 1200 amps. I also believe when an existing bank of large transformers are loaded to capacity that some consideration could be given to an additional bank to serve the new addition. This is a personal

Section 2321. Buildings of Large Areas. This exception to the fundamental rule may be applied only by special permission of the authority enforcing the Code which indicates that it is not to be treated lightly and applies only when the authority is satisfied that the con-

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ditions involved warrant same. I doubt if it is concerned with the application under discussion.

In answer to your specific question, the Code does not permit an unlimited number of services of the same characteristics that originate from separate transformer banks. Over 20 years ago such procedure was recognized. The present Code however would recognize separate services from different distribution systems.

During the past year official interpretation No. 425 was issued which should be of interest since it indicates factors that might be considered when deciding the issue under discussion. It reads as fol-

"Interpretation No. 425" "Section 2321; Service to Separate Buildings

"STATEMENT: An addition is being made to an existing school building. The buildings are separated by a fire wall with fire doors. There is an 18-ft passageway between the two buildings constructed with a fire resistant roof and a glass-wall panel construction over steel frames.

"The existing power supply is located across the existing building from the addition (some 300 ft distant) and is not adequate to serve the additional load.

"If the existing service equipment were used to supply the new building, the conduit run would have to be through or around the existing building and the cost would be extremely high.

"The local Building Department for zoning and other local reasons classifies the addition as a part of the original building rather than as a separate building.

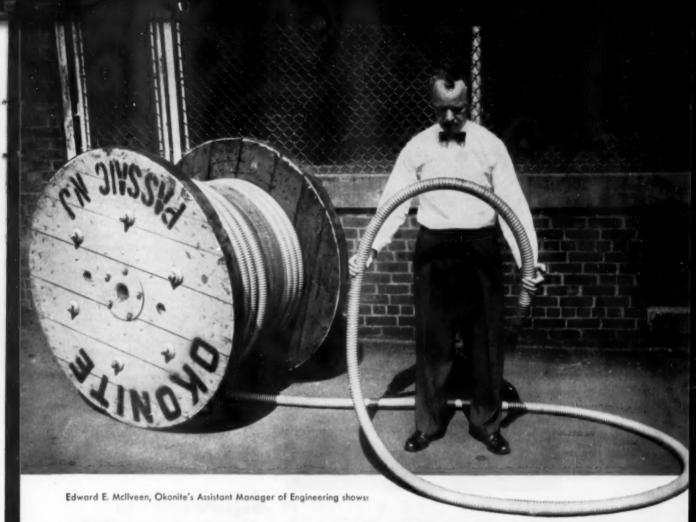
"QUESTION: Would a new primary, transformer, and service drop located adjacent to the new addition be in accordance with the intent of the Code either on the basis of the addition being a separate building or under the provisions of paragraphs c and d of Section 2321?

"ANSWER - YES.

"NOTE: Under this interpretation each building is considered as a separate unit electrically and there should be no electrical interconnection between them."— B.A.McD.

Service Equipment

Q. In a new residential suburban area, a real estate firm is erecting a number of rather large ramblers in which the speci-



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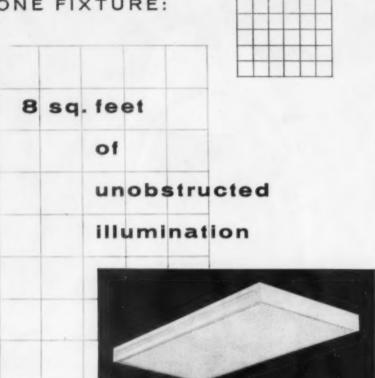
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fications call for the electrical service to be mounted in the garage located at one end of each of these ramblers. As they are from 75 to 112 ft in length, I am wondering whether or not No. 12 wire is adequate for the circuits extending from this service to the furthermost outlets in these dwellings .-V.G.

A No. 12 wire would not be adequate to extend a circuit from the service location in a garage at one end of a dwelling which might be 100 ft in length as the load in amperage of 15 amps at the end of a No. 12 circuit which was 100 ft from the service location via the path which the circuit wires take would have a voltage drop in excess of 4%. A No. 12 wire will carry 15 amps for 24 ft with a voltage drop of only 1%.

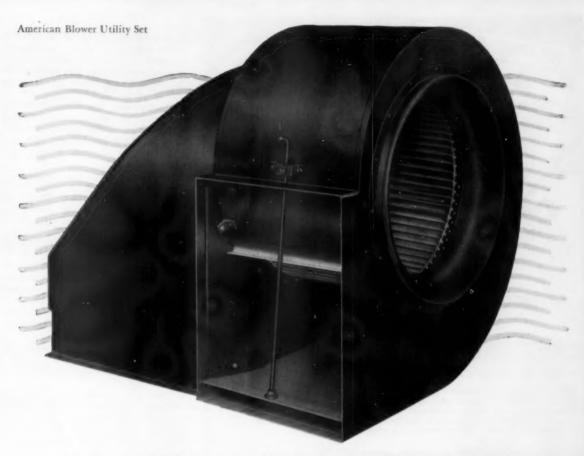
Therefore, where it is necessary to locate service equipment in the garage located at one end of an extended dwelling, it would be advisable to carry feeders to a distribution point more centrally located than the garage or even two sets of distribution equipments might be used where the dwelling approaches 100 ft in length .- G.R.

Magnetic Controller

We recently installed an electrical circuit and motor to operate an additional pump at a gasoline tank farm and now they wish to mount a stop button below the magnetically operated controller for this pump. Inasmuch as this stop button could have been placed within the enclosure for this magnetic controller, is it necessary to provide a sealing fitting in the short nipple which will extend from this magnetic controller to the stop button located immediately beneath?—S. T. W.

Section 5015 of the Code is A. rather specific in stating that in each conduit run entering an enclosure for switches, circuitbreakers, fuses, relays, resistors or other apparatus which may produce arcs, sparks, or high temperatures, seals shall be placed as close as practicable and in no case more than 18 in. from such enclosures.

Then in a fine print note contained in this section you will note the following statement: "Where two or more enclosures for which seals are required for which paragraphs 1 and 2 are connected



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by nipples or by runs of conduit not more than 36 in. long, a single seal in each such nipple connection or run of conduit would be sufficient if located not more than 18 in. from either enclosure."

Technically, the Code therefore will require that a sealing fitting be installed in the nipple between the magnetic controller and the stop button located below this device.—G. R.

EMT for Service Use

Q. There has been quite a lot of discussion recently in our city as to the advisability of using electrical metallic tubing for service entrance conductors. There is a question raised that the tubing will not satisfactorily withstand the weather. Has your experience given you anything definite whereby you can either prove or disprove this theory?

The question of strain does not enter into the problem, as the service drop will not be connected to

the tubing.

Can you define a wet location for me? I am thinking particularly of using No. 3 RH-RW wire in a conduit riser—would the 100-amp rating or the 80-amp rating apply? —C.R.A.

Insofar as the N. E. Code is concerned, electrical metallic tubing is recognized for use outdoors as a service riser, buried in the ground or embedded in concrete. It also is definitely recognized for use in a wet location as provided in Section 3484. Personally, I know of several installations where EMT has been used for enclosing service entrance conductors and my experience indicates that it has given satisfactory service. During the year I answer about 100 Code questions and over a period of many years, no question has come to my attention regarding the inability of EMT to give good service when used outdoors, exposed to the weather, as a service riser.

I am interested in the discussion which prompted your letter to me and I would appreciate your advice concerning any unfavorable experiences in your city or vicinity that would warrant a question with respect to use as an outdoor service riser.

A Wet Location is defined, under the heading "Location," by the Code under the definitions. It reads as follows:

"A location subject to saturation with water or other liquids, such as



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locations exposed to the weather, wash rooms in garages, and like locations. Installations underground or in concrete slabs or masonry in direct contact with the earth, shall be considered as wet locations."

A No. 3 RH-RW conductor has a current-carrying capacity of 80 amps when used in a wet location and 100 amps when used in a dry location. According to the above definition a service riser exposed to the weather is located in a wet location, and the current carrying capacity of the No. 3 RH-RW conductors would be 80 amps.

There could be a question however with reference to the term "exposed to the weather." What is intended? The weather in some parts of our country is very dry and hot, and outside of occasional rainstorms, the weather would not promote a "Wet Location." This factor I believe should be considered, and in the absence of an Official Interpretation, the authority enforcing the Code should be consulted.—B.A.McD.

Wiring For An Office Building

We have been called in to repair and remodel the wiring system in a six story office building which is seriously overloaded. The building is supplied with 3-phase 4-wire 208-volt and has a busway from the basement to the top floor supplying panels on each floor. The utility has advised us that they can supply this building with 480 instead of the 208 voltage of the present service. Can this present bus now carrying 208 volts be used to carry 480 volts to distribution points on the various floors of this building, and can we energize existing lighting circuits at 277 volts with suitable fixtures replacing existing units? -M.M.

Standard busways listed by A. the Underwriters' Laboratories are approved for voltages up to 600 volts. Therefore, if the present existing busways are listed by the Underwriters' Laboratories, they could be used to carry 480 volts. Existing lighting circuits supplying only fixture outlets could. of course, be used to supply 277volt fixtures as well as 115-volt fixtures. It will be necessary to locate transformers at various points of distribution in order to supply convenience outlets with voltage at 115 or 120 volts .- G.R.

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Code Status of Pole Service Switches

In reference to the National Electrical Code, Article 230, Section 2351-a, a 100 amp, 240-volt, 2-pole fused safety switch in a raintight enclosure is to be installed on a service pole located 30 ft from a residence. This switch is a disconnect for a 120/240-volt, 3-wire S.N., single phase underground service entrance. The service conductors in a conduit, terminate at the main lugs of a 20 circuit air-circuit-breaker load center without main breaker or switch and located on the inside building wall.

Does the location of the 100-amp main switch on the pole satisfy the requirement "Located at a readily accessible point nearest to the entrance of the conductors, either inside or outside the building wall", or will it be necessary to install an additional disconnect and overcurrent protection at the termination of the service entrance conductors?

—E.J.F.

If the switch in question is · fused and is approved as service equipment, the service to the property would terminate at the pole and the underground run to the residence would be classified as a feeder properly protected by the service fuse. In such a case the provisions of Section 2351-a would not apply to the feeder conductor where it enters the residence but it appears that the provisions of Section 2351-d would apply. Assuming that a service pole is a structure which the Code definition of a "Building" recognizes as a building, the feeder conductors entering the residence shall be provided with a readily accessible means of disconnect, within or adjacent to the building. Official Interpretation No. 288 issued May 16, 1947 indicates that under such circumstances the service switch at the pole would satisfy the disconnecting means required by Section 2351-d.

If the switch at the service pole does not contain the service fuses, the underground run to the residence are service entrance conductors and approved service entrance equipment, switch and fuses, or circuit breakers, must be installed at the point of entrance as covered by Section 2351-a. In the case presented we might contend that the service switch is at the pole and the service overcurrent devices are in the residence. I doubt however



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that such a combination was intended to satisfy the requirements of both Sections 2351 and 2371. Section 2372 requires the service overcurrent device to be an integral part of the service disconnecting means or shall be located immediately adjacent thereto with an additional exception which recognizes the overcurrent device at the outer end of the service raceway. I believe the word "immediately" indicates that the service switch and overcurrent device must be located within a foot or two of one another. Section 2371-a-3 also limits the number of overcurrent devices to six circuitbreakers or six sets of fuses but this present provision will be clarified in the 1956 Code to recognize more than six circuit breakers as now covered under Section 2351-a.

In view of the foregoing comment I would answer your question as follows in line with the variables which are involved:

No. 1. If the 20-circuit air circuit breaker assembly is approved by the U. L. as Service Equipment and the breakers are equipped with "handle ties" or "handles within 1/8 in. proximity" as covered by Section 2351-a, the requirements for service disconnect and overcurrent protection are satisfied regardless of the pole switch.

No. 2. If the pole switch is fused and is approved by the U. L. for service use, it is my opinion that no additional switch would be required in the residence. This opinion is based on the contention that a service switch on a pole located 30, 50 or 100 ft from the residence may be more accessible than one located in the basement of the house.

No. 3. If the conditions covered by either No. 1 or No. 2 do not exist, it appears to me that standard service equipment must be installed in the residence.-B.A.McD.

Floodlights For Gasoline Tank Farm

The owners of a gasoline tank farm are desirous of lighting the area about their property and have asked me to place a number of outdoor type floodlights on top of some of the storage tanks to accomplish this lighting job. Will these lights have to be of the explosion-proof type if they are mounted on the roofs of these storage tanks, all of which are much more than 15 ft above ground level?-L.T.C.



Ray Meadows, president of Evans Electrical Construction Company, Kansas City, reports that he used General Electric White on the Lawrence Water Works installation because:

"The men say

General Electric White is easiest to handle . . . and it cuts installation costs as much as 20%"

"Our installation costs drop between 10% and 20% on branch circuit conduit work and from 5% to 10% on feeder circuits when we use General Electric White," reports Mr. Meadows. "Not only that—the men prefer working with G-E White. They find that even the larger sizes do not split, crimp or fracture, that all sizes bend easier and more uniformly than other conduit. Threads are always good and clean and need no "chasing". Cutting and threading are easy and uniform.

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BLACKHAWK INDUSTRIES

Any lighting fixture mounted on the roof of a tank containing volatile flammable liquids, such as gasoline, or any other flammable liquid having a flash point below the ambient temperatures which may occur, should be of the explosion-proof type even though they are located more than 20 ft above the surrounding ground level if the tanks are provided with open vents or if the tanks are of the floating roof type. Some tank farms have all tanks containing such volatile flammable liquids designed with vapor recovery systems so that no tank has open flame arrester type vents, and in such a case it would be possible for the inspection authority having jurisdiction to accept other than explosion-proof Class 1 Group D equipment mounted on the roof of such a tank. It is true that Section 5125 of the Code does provide that the hazardous Class 1 area extends only 25 ft horizontally from such sources of volatile vapors and to a height of only 15 ft above adjacent ground level. It further qualifies this, however, by saying "unless the code enforcing authority judges otherwise." Most such authorities use this 15-ft rule not only above the ground but also above any point from which gasoline vapors may be liberated during normal operation of such a tank farm. As an illustration, at tank loading stations they usually figure this area to extend 15 ft above the tank trucks or tank cars which are filled due to liberations of explosive vapors from the tops of such tanks during filling operations.-G.R.

Receptacle Loading-**Branch Circuits**

Does NEC specify any particular method for determining the number of power consuming outlets which may be attached to circuits in residential occupancies, other than small appliance circuits and fixed appliance circuits?-J.J.D.

I assume from the wording of your question that the power consuming outlets are receptacles. While the Code does not specifically cover the number of outlets permitted on a branch circuit, various limitations are provided which limits the loading. As an example, Section 2121-a covers the carrying-capacity of a branch circuit and provides that the con-



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ductors shall be of a size not less than the maximum load to be served and not less than the rating of the branch circuit. Section 2116-b recognizes 1.5 amps per outlet within the limitations covered by this rule. Sections 2102 and 2125-a advise that Article 430 applies when a branch circuit supplies only motor loads. Section 2125 limits the maximum load on a branch circuit, which supplies both motor operated appliances and other types of loads to 80% of the circuit rating. Section 2126 also places limitations on the various types of branch circuits with respect to loading.

In view of the many variables involved, it is impracticable to cover all of the various applications in an article of this nature. I will assume therefore that the power outlets mentioned are intended to supply motor loads only such as room air-conditioners, which are connected to the circuit by the use of a cord and receptacle. Under such conditions the applicable rules of Article 430 apply.

Section 4343 recognizes the connection of two or more motors to the same branch circuit when the motors are rated 1 hp or less and each not exceeding 6 amps provided the circuit is protected at not more than 20 amps at 125 volts. It also recognizes a 230-volt circuit protected at 15 amps. In applying this rule to small room air conditioners, interim amendment No. 101, effective January 1, 1955 also enters the picture. This amendment will appear as Section 4293 in the new Code. It reads as follows:

1.—The total load of motor operated air-conditioning equipment shall not exceed 80% of the rating of a branch circuit which does not supply lighting units or other appliances.

2.—The total load of air-conditioning equipment shall not exceed 50% of the rating of a branch circuit if lighting units or other appliances are also supplied.

In applying both of these Code rules, Section 4343 and new Section 4293, we would find that the number of receptacles installed on a circuit would be limited as follows:

1.—115-volt circuit, No. 12 wire, 20-amp overcurrent device. This 20-amp circuit is limited to 16 amps maximum load due to the 80% factor. As a result we could only connect two 6-amp conditioners to such a circuit.

2.—230-volt circuit. No. 14 wire, limited to 15-amp protection. This circuit is derated to 12 amps and

"Stop crying...

I told you to use a Circle F device!"



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- Top Quality so that customers can depend on your product Excellent Service to help clients with electrical problems
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Eastern Insulated Wire Corp.

Wallingford, Conn.

A subsidiary.

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And, most important, you can be assured that your client will be satisfied with his system for years to come . . . because Kellogg quality assures a minimum of maintenance, and because Kellogg guarantees availability of service forever.

Call in your Kellogg dealer, or send coupon for the Kellogg Planning Kit today!



KELLOGG SWITCHBOARD AND SUPPLY CO.

A Division of
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QUALITY COMMUNICATIONS SYSTEMS

QUALITY COMPONENTS FOR INDUSTRIAL CONTROL

Dealers in principal cities of United States and Canada

Kellogg Switchboard and Supply Co., Commercial Product Dept. 89-J, 79 W. Monroe Street, Chicago 3, Illinois	16
Gentlemen:	
Please send me the Kellogg Planning Kit.	
NAME	
	KELLOGG
NAME	PLANNING KIT

we could connect either two 6-amp or three 4-amp conditioners to such a circuit.

This example intends to show that the number of outlets on either type of circuit is restricted not on the basis of so many outlets to be served but on a more positive basis of the size and character of the load to be served.

An article appearing in the January issue of the News-Bulletin of the International Association of Electrical Inspectors covers this subject in more detail.—B.A.McD.

Window Air Conditioners

An office building in our city has now installed so many window air conditioning units that they have overloaded their present wiring system making it necessary that we replace the service with one of proper capacity and also provide circuits to serve these units, the largest one of which is not over one horsepower. Must we run a separate circuit for each of these units?—J.M.C.

The Code would not require that a separate circuit be run for each window air conditioning unit as paragraph b. under Section 4343 provides:

"Two or more motors of any ratings, each having individual running overcurrent protection, may be connected to one branch circuit provided all of the following conditions are complied with:

 Each motor-running overcurrent device must be approved for group installation.

2. Each motor controller must be approved for group installation.

3. The branch circuit must be protected by fuses having a rating equal to that specified in section 4342 for the largest motor connected to the branch circuit plus an amount equal to the sum of the full load current ratings of all other motors connected to the circuit.

4. The branch circuit fuses must not be larger than allowed by section 4330 for the thermal cutout or relay protecting the smallest motor of the group supplied by that circuit.

5. The conductors of any tap supplying a single motor need not have individual branch circuit protection, provided they comply with either of the following: (1) no conductor to the motor shall have a current carrying capacity less



there's a Wheeler fixture for every job

In industry after industry, on job after job, Wheeler's wide range of fixtures and features insures peak efficiency for practically every lighting requirement. Shown here: three outstanding examples of Wheeler's tremendous line of industrial lighting fixtures.



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There's a Wheeler Incandescent or Fluorescent Lighting Fixture to meet every industrial requirement. Wheeler Reflector Company

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AND YOU'LL BENEFIT FROM IT'S IN-CREASED EFFICIENCY and CAPACITY FOR PRODUCTION

Your remarkable use of Rawl products made this new plant possible. It replaces our outgrown facilities.

Of course, we made sure you earned a good profit on our products as you used them.

We made a profit too—and we're plowing part of it back into this new plant to give you still better service, better products and more of them—so that you can earn more in the future.

President



than that of the branch circuit conductors, or (2) no conductor to the motor shall have a current carrying capacity less than one-third that of the branch circuit conductors, with a minimum in accordance with section 4312; the conductors to the motor running protective device being not more than 25 feet long and being protected from mechanical injury."

You will also note under section 4330 that thermal cutouts, thermal relays and other devices for motor-running protection which are not capable of opening short-circuits, shall be protected by fuses or circuit breakers with ratings or settings of not over four times the rating of the motor for which they are designed, unless approved for group installation, and marked to indicate the maximum size of the fuse by which they must be protected.

Therefore it will be necessary for you to examine the window air conditioning units because the type of overcurrent motor running protection device will determine the number of units you may supply from any one circuit.—G.R.

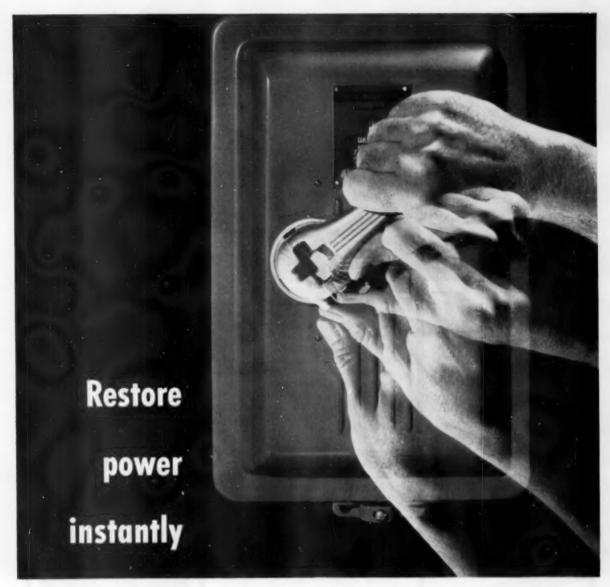
Conduit Supports

Q. Recently we installed a conduit in a building supporting same with Minerallac hangers to the top of a water pipe going to a cooling tower on an air conditioning system.

The electrical inspector turned this installation down for reasons which he contends that at some future time the water pipe may be removed, and conduit would be left suspended in mid air, and also reasons that the plumber had installed pipes for his own use, and we should not take advantage of labor savings by his efforts.

Did we violate any article of Code in supporting to water pipe as mentioned above?—C.P.M.

A Section 3004 of the N. E. Code requires a rigid conduit installation to be securely fastened in place. Specific details with respect to the procedure to be followed are omitted in view of the many variables involved and the "Introduction" to the Code places the responsibility for interpretation in the hands of the authority enforcing the Code. In the case of concealed conduit, buried in masonry, the need for support is minor compared to an exposed conduit. When conduits are exposed



...at no

extra cost!

By merely flipping the handle you restore power instantly, safely, with circuit breakers on the job. And Westinghouse AB-I's provide that advantage at no extra cost.

In fact, many AB-I breakers cost less than safety switches.

Without fuses to replace, that nuisance factor and maintenance expense is gone forever...machine down time is greatly reduced. And power loss, a characteristic of many other protective devices, is virtually eliminated making possible power bill savings throughout the years.

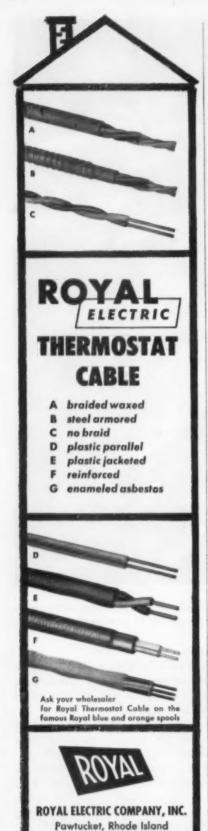
AB-I's cost less to install. The Westinghouse separate packaging plan for enclosure and breaker assures that. You get accurately calibrated units to protect your line, units front-operated for gang mounting.

Can't you use a reduction in down time, in many cases up to 98%, in your operation? Call or write Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pennsylvania.

J-30224

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the number of supports varies with the size of the conduit, the location of the conduit and the horizontal or vertical position of the conduit. These are a few of the many variable conditions which concern the support of conduits and it appears evident that it is beyond the scope of the Code to endeavor to specify specific details for each of the variable conditions of use. This is the responsibility of the electrical inspector.

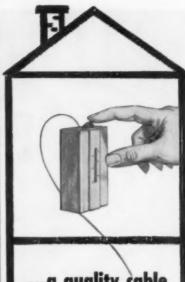
In view of the above it is my opinion that your installation is in violation of the Code on the basis of the inspector's interpretation and the only action left is recourse to an official interpretation.

Personally, I fully concur with the Inspector's findings in this case. In general, the wiring system of a building should be so installed that it is entirely independent of other systems in the building. In the case in question the conduit system should be supported independent of the water pipe system, and I believe that the plumber, if he knew about it, would insist that such procedure be followed. Both systems are subject to maintenance and possible future alterations, and repairs on one system could be damaging to the other or would be impeded by the proximity of the two systems. The electrical contractor is responsible for his electrical installation but when he uses other systems as a means of conveniently satisfying his needs he assumes an additional responsibility for the proper operation of both systems. I do not believe that the plumber, under similar circumstances, would consider using a run of conduit for a support of his water pipe system and if he did, I imagine the electrician would tell him to keep off. B.A.McD.

Appliance Circuit

Q. I have just started roughing in a wiring installation for a good sized motel being erected here and the question of appliance circuit requirements has come up. Does the Code require a separate appliance circuit in each dwelling unit of a motel building? If an appliance circuit is installed, could it also supply a receptacle which might be used for general use purposes?—M.C.M.

A. The question of whether or not an appliance circuit is necessary in a motel apartment or



...a quality cable for every control installation!

Whatever the job . . . new installations, rewiring, or repairs . . . decide NOW to specify ROYAL ELECTRIC Thermostot Cable for your fall and winter requirements. ROYAL dependability is built into every foot, to meet your highest standards and to insure trouble-free service and satisfied customers.

Available from your wholesaler, in all types and sizes. Order NOW . . . and specify ROYAL!



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▲ TWO-AND-A-HALF-INCH SEALTITE containing motor lead cable is attached to rigid conduit on Super Heavy Weight Champion Drill. Flexibility of Sealtite means fast, simple installation.

♦ ONE-INCH SEALTITE is installed to junction box. This particular box is necessary because tower must be removed for shipping. Sealtite withstands weathering, dust and vibration.

HEAVY WEIGHT CHAMPION Drill takes 40 feet of Sealtite in three sizes. Big brother, Super Heavy Weight, uses about 200 feet of flexible, liquid-tight conduit.



Flexible, liquid-tight conduit speeds up wiring on blast hole drills

"Sealtite" cuts installation time 20%—drill manufacturer reports

This large drill is not pampered. It is used in the field under every conceivable climatic and atmospheric condition. Thus, every component, including the electrical conduit, must be rugged to stand the weather, the abrasive dust and severe vibration.

Formerly, the manufacturer used a rigid type of conduit. But it was difficult to install around bends and in tight spaces. In 1953, they switched to Sealtite flexible, liquid-tight conduit. This flexible conduit has meant a 20% saving in labor time, improved the appearance of the wiring job—

and all the time has delivered 100% in the field.

Manufacturers find Sealtite easier to stock...takes up less storage space.

WHERE TO GET SEALTITE

Electrical wholesalers stock Types U. A. and E. F.† Sealtite* flexible, liquid-tight conduit in easy-to-handle coils. Be certain you ask for, and get, the quality conduit marked "Sealtite" on the cover. Buy it in long lengths and cut it on the job without waste. Special liquid-tight connectors by

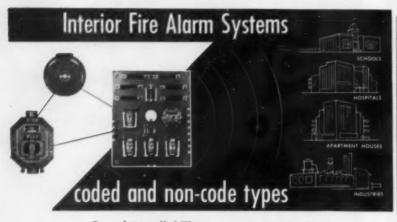
Appleton, Thomas & Betts, Gedney or Pyle-National are available. Free Booklet S-537 gives full information on Sealtite. Write: The American Brass Company, American Metal Hose Division, Waterbury 20, Conn.

*Trude Mark 1Pal. Applied for 68102

SEALTITE

flexible, liquid-tight conduit

an ANACONDA® product



Complete reliability is the one thing we demand from a fire alarm system. Therefore, when ordering interior Fire Alarm Systems, be sure to specify equipment (control panels, stations, and fire alarm bells) produced by Wheelock Signals, Inc., the originators of A-C Fire Alarm Systems.

Both coded and non-code types are available in various arrangements depending on type of building or establishment.

Although Interior Fire Alarm Systems are intended primarily in principal cities for warning occupants of a building, they can be connected assist in specifications.

Write for Bulletin FA-3





unit is determined by whether or not the units of the motel are simply sleeping rooms or are regular apartments having kitchens and other housekeeping facilities. If each unit has kitchen facilities. then the Code will require that at least one appliance circuit be installed serving outlets only in the kitchen or eating portions of the unit which might be used for the connection of cooking appliances. Convenience receptacles used for general use purposes cannot be placed upon an appliance circuit but may be placed on the same circuit serving the lighting fixtures within the unit. We might call your attention to the fact that such convenience receptacles will have to be spaced not more than 12 ft apart as the spacing rule contained in the 1956 Edition of the National Electrical Code has now been changed to require 12-ft spacing instead of 20 as required in the 1953 Code. If the motel has no cooking facilities in each unit and if the management prohibits guests from bringing in hot plates or other cooking appliances, it would, of course, be unnecessary to provide an appliance circuit.-G.R.

Wiring For A School

Plans are now being prepared for the construction of a large high school in our city and I have been asked to assist the architect in preparing the electrical specifications for this building. May we use 277-volt circuits to light this building if we keep the fixtures 8 ft above the floor.—G.E.T.

Under section 2113 of the A. Code, you will find permission given in large schools to have circuit voltages in excess of 150 volts to ground where such circuits supply only ballasts for electric discharge type lamps in permanently installed fixtures mounted not less than 8 ft from the floor. You will also notice that fixtures connected to 277-volt circuits cannot have switch control which is an integral part of the fixture making it necessary to use wall switches or switches in distribution cabinets for the control of these lights. All circuits supplying convenience outlets, ordinary lampholders, etc. must, of course, operate at voltages not to exceed 150 volts to ground .-

G-E LAMPS GIVE YOU MORE FOR ALL YOUR LIGHTING DOLLARS



General Electric fluorescent lamps "should live so long"... and they do!

IT would be most unusual for you to buy a whole carton of 24 G-E 40-watt fluorescent lamps to keep a single socket supplied. If you should, however, based on the average service life of 3 years per lamp, you wouldn't need to buy another lamp for that socket for 72 years . . . until the year 2028!

HOW G-E LAMP UNIFORMITY AFFECTS LIFE—Long life is important, but also important is uniformity of life—the "spread" between the first and last burnouts in a group of lamps. After one year of service in single shift plants an average of 99 out of 100 General Electric 40-watt fluorescents will still be burning. That's 2500 hours of service. In double shift plants, 98 of 100 will be burning after a full year! General Electric 40-watt fluorescent lamps not only live up to their published rating of 7500 hours life, but have virtually no early failures.

GENERAL ELECTRIC LAMPS SAVE YOU MONEY. Lack of early failures can help cut your lighting costs. For example, G-E lamp uniformity lets you set up and stick to a group relamp-

ing schedule, cutting maintenance costs. Fewer individual lamps to spot replace.

In addition to uniform life, General Electric 40-watt fluorescent lamps on the average are 99,9% free from physical defects that could affect performance in service! And they are uniform in light output; less than 1% of all G-E 40-watt fluorescent lamps are as much as 5% below their published light output of 2500 lumens.

For more information on how you benefit from G-E fluorescent lamps write: General Electric Co., Large Lamp Dept., EC-10, Nela Park, Cleveland 12, Ohio.

Progress Is Our Most Important Product

GENERAL 🝪 ELECTRIC

Wagner ELECTRIC MOTORS ... the choice of leaders in industry

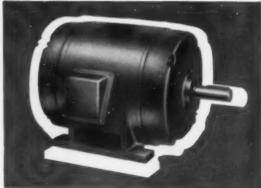


You get better performance with these Wagner DP Motors

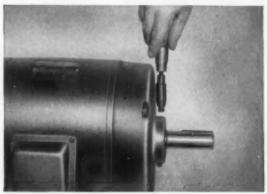
Wagner DP motors are doubly protected by (1) rugged, corrosion-resistant cast iron frames, smoothly rounded so that no moisture can collect on them. Motor feet are cast as an integral part of the frame for maximum strength and rigidity. (2) Enclosures on the DP motor are completely drip-proof—virtually splashproof. Air intakes are located at the bottom of the endplates and air outlets are located at the base of the frame—one on each side.

Although engineered to meet the re-rated NEMA specifications which call for more power in smaller frames, the same high quality and long life performance that have made Wagner Motors "the choice of leaders in industry" for many years has of course been retained.

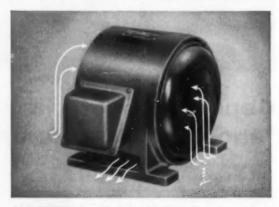
Full information and principal dimensions are given in Bulletin MU-202. Write for your copy today.



MORE POWER IN SMALLER FRAMES The Wagner DP Motor packs more power in a smaller frame and this smaller size means ease of handling and stocking...less space required for installation.



CAN BE RE-GREASED FOR LONGER LIFE This motor will operate for years without regreasing... bearings are completely enclosed ... however, provisions have been made for adding lubricant and for the removal of old grease in cases where re-greasing is necessary.



COOL RUNNING Specially designed baffles direct cooling air from the blowers through the motor and provide protection for the stator windings. Blowers are an integral part of rotor...and move large volumes of air without noise or vibration.

Wasner Electric Corporation 6413 Plymouth Ave., 5t. Louis 14, Mo., U.S.A.

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ELECTRIC MOTORS - TRANSFORMERS - INDUSTRIAL BRAKES - AUTOMOTIVE BRAKE SYSTEMS-AIR AND HYDRAULIC

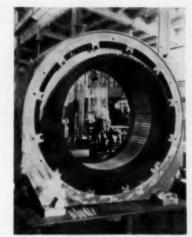
Motor Shops

Test Armature Speeds Repair

At the shop of Master Electric Motor Repair, Paramus, N. J., Louis Daehnke, chief armature winder, finds speed, ease and precision of work in the use of a simple test armature for testing rewound stators. As shown in the accompanying photos, this is a small squirrel cage armature with one end of its shaft set in a double bearing arrangement mounted in the center of a flat supporting plate. The armature is held firmly in a vertical position but is completely free to rotate in the well-lubricated bearings.

To use the test armature, the stator to be tested is placed over the armature on the bench, as shown, and the stator windings are connected to the power supply line. When the stator fields are set up, magnetic coupling and interaction with the rotor conductors will cause the armature to rotate. This is true with large and small stators—provided the bore of the stator is large enough to accommodate the size of the armature and allow it to rotate freely. As larger and larger stators are used with the test armature, the torque exerted on the armature decreases due to the widening air gap, but the rotor will still rotate.

The test armature can be used to check for direction of rotation, sequence of rotating fields, grouping and polarity of coils and other characteristics of the magnetic fields and motor action. Both single-and 3-phase stators can be checked quickly and readily.



600 HORSEPOWER motor, wound with coils having durable insulating laminate of glass cloth and mica-filled plastic on epoxy resin base, greatly lengthened service life under severe operating conditions. Development was by Larson-Hogue of Los Angeles.

TEST ARMATURE is simply a small squirrel-cage rotor, set in bearings in a flat steel end plate. A piece of cardboard is shown here over the plate with the rotor sticking up through a hole in the cardboard. The stator to be tested is at right.

Resin-Base Insulation Triples Coli Life

Larson-Hogue Electric of Los Angeles recently developed, with the engineering assistance of the Epoxylite Corporation, some new coils for a 600-hp motor, using a durable laminate of glass cloth and mica-filled plastic insulation on a special resin base. The development was prompted by recurrent burn-out problems being encountered in rubber plants, where fine particles of carbon black would adhere to coil surfaces and work their way into microscopic crevices in conventional coil insulation. As these deposits gradually build up in volume, current would be grounded and motors would be short circuited. Since this condition frequently developed in less than six weeks after rewinding a motor, downtime was great, while repeated charges related to removal and repair of equipment were ex-

Larson-Hogue found that, by using a dense seal of dielectric material having none of the voids of conventional insulation, all foreign matter such as carbon black, metal dust and dirt was excluded from windings, and coil life promptly tripled in length. A seal such as this, based upon the properties of

Bakelite epoxy resin, would also exclude acids, alkalies, oils and most solvents, making it applicable for tough applications frequently encountered by railway traction armatures, Banbury mixers and motors subjected to similar abuse. It is also designed for insulating motor windings used in the continuous-process industry, in petroleum pumping stations, for sewage disposal and on mining equipment. That is, it should prove advantageous wherever moisture, contamination and vibration combine to form severe operating condi-

The resin used in this insulation has proved to be an excellent adhesive and, when installed under high temperatures and pressure, the plastic and glass-cloth laminate becomes firmly bonded to coil windings.



TESTING OF STATOR is done by placing stator over the rotor, resting jt on the cardboard on top of the plate. Then by connecting power supply to the stator windings (insulated clips are 110 volts) the operating condition of the stator windings can be determined. Both direction and speed characteristics can be observed and evaluated by an experienced operator.

Coil Holder Operated By Foot Pedal

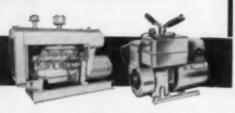
Coils are conveniently and easily taped at the Industrial Electric Co., York, Pa., by employing a spring-tension foot-operated device that holds coils firmly in position securely.

As indicated, this device, located

SELL AND USE . . .

UNIVERSAL ELECTRIC POWER AND LIGHT PLANTS

YOU PROFIT



1. Tap the big emergency power plant market with the Universal line . . . supply householders, businesses, institutions, etc. Universal offers you more—in suitable models, fast deliveries, low, easy-selling prices. Air- and water-cooled models, gasoline or diesel powered, from 250 watts to 35 kv.

2. Profit from instant on-the-job power! Avoid problems and delays of hooking into regular service. Lightweight, low-cost Universal models to handle all your power from 250 watts to 35 kw.

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ELECTRIC POWER AND LIGHT PLANTS MARINE ENGINES All the information, specifications, pictures on Universal air-cooled modcls at your finger tips. Ask for helpful Bulletin FSE. 2; also other gasoline, diesel literature. Write Universal Motor Co., 438 Universal Drive, Oshkosh. Wis.



Here's how STANDARD helps solve Transformer Problems

Dry-Type Load Center Transformer, 1000 KVA, with primery disconnect switch and low-voitage circuit breaker, One of a complete line of transformers developed by Standard for every class of indoor or outdoor service.



Call your nearby Standard Transformer engineering representative. He'll work with you to determine the best solution for your unit sub-station problems and will present an efficient, economical solution. No need to choose stock designs. Standard will incorporate any special components you specify. Let us show you how you can have the best transformer for the job. Call your Standard representative today!



WARREN, OHIO REPRESENTATIVES IN PRINCIPAL CITIES

FLAT STEEL STRAP, welded at right angles to a bench-piercing rod, can be clamped down by foot pressure and raised by spring action.

at the front corner of a work table, is comprised simply of a steel shaft that runs through a metal tube attached to the table leg.

A flat piece of iron has been welded at right angles to the top of the shaft that passes up through the table top. Another section of flat steel sheet has been secured to the bench surface to form a base plate for the clamping head.

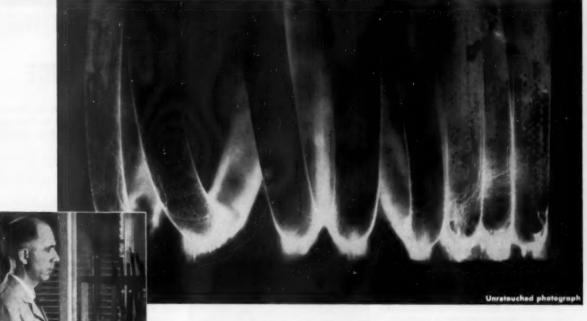
Foot pressure draws the head of the steel shaft downwards so that it grasps a coil placed between the head and the steel sole plate. This foot control can be locked in place if desired. When this lock and the foot control is released, the shaft is raised by spring tension and the clamp is thereby released.



LAMP GUARDS, fabricated and painted aluminum in the motor shop of the Krug Electric Co., Inc., are hung to dry by head winder Robert Strom. These guards, made in varying lengths to match standard fluorescent lamp sizes, are installed on printing presses by motor service personnel during routine maintenance calls to prevent lamps from vibrating loose.



GRIZZLY® POWER CABLES



Under High Ozone Attack resulting from excessive voltage outlast 9 other leading brands tested!

In United States Rubber Company's special wire and cable testing laboratory, scientific devices record how cables react under abnormally high voltage.

In this test, 6 samples of 5 KV unshielded U. S. Grizzly Power Cables were pitted against 26 other 5 KV samples made by 9 leading competitors. Lengths were bent into U-shapes, roughly 8 times the cable's over-all diameter. They were then placed upright on a grounded metal plate with bottom of "U" resting on plate. Then a conductor-to-plate potential of 40,000 volts was applied. The test was allowed to run until all cables failed, with elapsed time to failure carefully checked for each. The accompanying chart shows dramatically the overwhelming superiority of U. S. Grizzly Power Cable.

U. S. Grizzly Power Cables are obtainable at your "U.S." branch, distributor, or write us at Rockefeller Center, New York 20, N. Y.



Manufacturer	No. of samples tested	Elapsed time to Lowest value	
"U. S."	6	2941	6030
A	2	0	3
В	5	0	92
C	2	0	.6
D	3	12.5	144
E	3	300	490
F	2	30	46
G	6	.1	2509
Н	2	0	0
1	1	25	25



Electrical Wire & Cable Department

United States Rubber

In The News

Highlights of the

1956 IES ANNUAL CONFERENCE

The Illuminating Engineering Society held its 1956 annual national technical conference in Boston last month. It was a four-day meeting, attended by some eleven hundred members, visitors and guests, from across the nation, Canada, Hawaii and England. A major highlight was the Society's culmination, during this conference, of the celebration during 1956 of its fifty years of history and growth since its founding in 1906.

Features of the technical program itself included reports on newest developments in practical lighting, and the newest research advances in the field-to representatives of every branch of the lighting industry and of professions and businesses touching upon the lighting field. Technical sessions covered such topics as daylighting, lighting calculations, light sources, street lighting, lighting research, lighting applications, a forum on residence lighting, and the presentation of an outstanding lighting solution by each of ten contestants who had qualified for the final runoff in the Society's "My Most Interesting Lighting Job" contest. Also, one evening session was devoted to a dramatic and highly interesting and entertaining demonstration report on lighting progress and advances in light sources and equipment. Social highlights included an Arthur Murray presentation of Cavalcade of Dances (1906-1956, an IES Golden Anniversary tribute), a clambake at Plymouth, Mass., and the President's reception and dance, among others.

Daylighting Session

Four technical papers were presented on phases of daylighting. "Daylighting Design With Adjustable Horizontal Louvers", a paper authored by J. W. Griffith, Southern Methodist University, E. W. Conover, Fenestra, Inc., and W. J. Arner, Libbey-Owens-Ford Glass Co., presented a method of predicting daylight illumination on the work plane of rooms using adjust-



LIGHT SOURCES are displayed at the 1956 Golden Anniversary IES National Technical Conference by (I. to r.): R. B. Brown, Jr., chairman Conference Executive Committee—Paul Revere's lantern from Old North Church; Robert F. Hartenstein, President—replica of Edison's first electric lamp; and Marshall N. Waterman, President-elect—modern mercury reflector lamp.

able horizontal louvers as a means of daylight control. This method was the result of a joint study of adjustable louvers by the three authors.

A simple method of correlating solar radiation measurements with available daylight, which will enable architects and designers to determine in planning stages the required amount and type of fenestration needed to give a predetermined daylight level anywhere in the country, was outlined by H. F. Kingsbury, Director of Pittsburgh Corning Corp's. Daylighting Research Center. His paper was titled "Availability of Daylight".

"Measurements in Daylighted Classrooms in Arizona" covered a report by J. R. Williams, Arizona Public Service Co., Phoenix, on daylight conditions existing in four classrooms, each in a separate school, over a three month period. It was his conclusion that "as yet the use of natural daylight for

illumination purposes in classrooms has not been subjected to the precise control that is typical of artificial illumination".

Applications Session

Seven papers were devoted to lighting applications.

W. H. Johnson, of Westinghouse Electric Corp., Cleveland, reported that studies conducted on commercial and industrial lighting by him, using the new high output fluorescent lamps, indicated the new lamps might be used in existing industrial reflectors, provided care is used in shielding, but that the use of these lamps in existing commercial type luminaires, including recessed units, is not very practical. New luminaires, with better shielding and improved ventilation, should be designed, he said.

A. L. Hart, General Electric Co., Cleveland, outlined "Some Factors That Influence the Design of Daytime Effective Exposed Lamp Signs", and reported that the apparent size of an exposed light source (spot size) when seen at a distance is the key to sign design.

Carl J. Allen, General Electric Co., Cleveland told how to light a room for "Audio-Visual Teaching", and described and illustrated a variety of projection lamps, types of movie and slide projectors, dimming systems, and supplementary aids and techniques for both the speaker and the audience.

Sanford C. Peek, Sylvania Electric Products Inc., Salem, Mass., described and demonstrated a new small, bright, uniform light source, which is excited by radio frequency, and discussed its potential applications.

James R. Bale, Westinghouse Electric Corp., Cleveland, discussed "Mercury Floodlighting—Its Advantages and Limitations", and concluded that "for all general floodlighting installations operating 300 hours a year or more at an energy rate of ½-cent per kwh or more, mercury floodlighting would definitely have an economic advantage".

there's a combination starter you KNOW is Safe!

Bulletin 712 Combination Starter consists of a standard Bulletin 709 acrossthe-line starter mounted in a cabinet with an A-B manual disconnect switch. Fuse clips are optional.



OPERATING LEVER CAN BE PADLOCKED IN "OFF" POSITION

You can use from one to three padlocks to lock this starter in the "off" position-or, for unusual applications, change it to permit padlocking in the "on" position.



The disconnect switch lever is so interlocked that the cover of the cabinet cannot be opened until the disconnect switch is "open" and the starter is "dead."

COVER ITSELF CAN BE PADLOCKED

Provision for locking the cover to the base of the cabinet with a padlock eliminates all possibility of tampering with the mechanism.

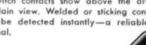


INSULATING SHIELD COVERS "LIVE" LINE TERMINALS

With the cover open, only the incoming line terminals are "alive"—and in Allen-Bradley Bulletin 712 starters, these are covered with an insulating shield.

MOVABLE CONTACTS ARE PLAINLY VISIBLE IN "OFF" POSITION

When in the "off" position, the movable dis connect switch contacts show above the arc hood in plain view. Welded or sticking contacts can be detected instantly—a reliable safety signal.





BULLETIN 712 COMBINATION STARTER

Five distinct safety features give "plus value" to this new line of Allen-Bradley Bulletin 712 Combination Starters. And-you also get the design simplicity and the many other advantages for which the Allen-Bradley solenoid starter has earned its "quality" reputation.

Available in NEMA Types 1, 4, 7, 9, and 12 enclosures, from 1 to 100 hp, 220v; 200 hp. 440-550v.

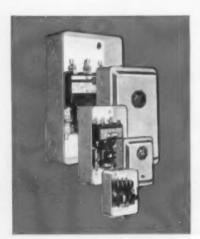
ALLEN-BRADLEY MOTOR CONTROL

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis. In Canada - Allen-Bradley Canada Ltd., Galt, Ont.

This simple design remains "tops"



that's why it's good for



Shown above are five sizes of the Bulletin 709 across-the-line solenoid starters. Three larger sizes are also available with a maximum rating of 300 hp, 220 volts; 600 hp, 440-550 volts.

millions of operations!

The solenoid plunger shown above is the only moving part in any Allen-Bradley solenoid starter. Its straight up-and-down action is practically frictionless. There are no pivots, pins, or hinges to stick and cause trouble. That's why you are assured of millions of trouble free operations.

All Allen-Bradley solenoid starters have double break, silver alloy contacts that never need service attention of any kind. You just install them and forget them. On more and more automatic production machines, where continuity of operation is a "must," Allen-Bradley motor starters are standard equipment. Try them on your tough jobs!



ALLEN-BRADLEY
SOLENOID MOTOR CONTROL

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis. In Canada—Allen-Bradley Canada Ltd., Galt, Ont. J. H. Campbell and D. D. Kershaw, General Electric Co., Cleveland, reported on "Flashing Characteristics of Fluorescent Lamps", and submitted test data to illustrate lamp and circuit requirements and to serve as a guide to ballast manufacturers and users of fluorescent flashing system.

R. W. Bunner of General Electric Co., Danville, Ill., and R. T. Dorsey of General Electric Co., Cleveland, described "Flashing Applications of Fluorescent Lamps", and illustrated by working models some of the spectacular changes in pattern, emphasis, texture, etc., which can be produced by flashing from one color circuit to another. Spectral distribution curves of white and colored fluorescent lamps, and the effect of one color of light falling on pigments of other colors were also discussed and demonstrated.

Calculations Session

"Interflections in a Room With Luminous Walls", was presented by Hempstead S. Bull, University of Michigan, and consisted of test data taken in a model room plus discussion of the data.

"Analysis of Experimental Data For Interflectance Theory" was made by Robert S. Wiseman, Engineer Research and Development Laboratories, Fort Belvoir, Va., and consisted of the comparison of results obtained by various investigators, and illustration of the effects the indicated variations in each component has on the total.

"Algebraic Interflectance Computations" was presented by J. R. Jones, Westinghouse Electric Corp., Los Angeles, Calif., and John J. Niedhart, The Miller Co., Meriden, Conn.

"The Effect of Furniture on the Coefficient of Utilization" was reported by Domina E. Spencer, University of Connecticut, Storrs, Conn., in which was presented a simple method of taking into account the effect of irregularities in room enclosures and the effect of furniture—not included in the empirical formulas of Harrison and Anderson which were for empty rooms.

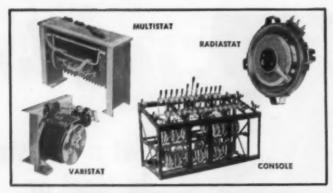
Light Sources Session

Eight papers were presented covering various developments and studies relating to light sources.

Willi Lehman, Westinghouse Electric Corp., Bloomfield, N. J., reported on "The Efficiency of Electroluminescence". The report related luminous efficiency of powdered phosphors to variable voltages



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Lighting dimmers for FREE-STANDING BOARDS . CONSOLES . WALL MOUNTING PANELS

You'll find a dimmer for every application in Ward Leonard's adjustable autotransformer line.

For example, there's the 2.5 kW VARISTAT, the 6.6 and 8 kW RADIA-STATS, and the 6 and 12 kW MUL-TISTATS for interlocking or noninterlocking control. Manual or remote-control motor operated. Learn more about autotransformer dimmers for compact fullrange, flickerless and efficient lighting control of incandescent and fluorescent lighting. Write for Bulletin 76. Ward Leonard Electric Co., 33 South Street, Mount Vernon, N. Y. (In Canada: Ward Leonard of Canada Ltd., Toronto).

WARD LEONARD ELECTRIC CO.

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and variable frequencies, and indicated some simple laws which were discussed. The author reported that "two years of intensive work caused an improvement in brightness of a factor of 200 and in efficieny of a factor of 15—the future (of electroluminescence) looks encouraging".

Theodore C. Retger and George W. Gerung, Westinghouse Electric Corp., Bloomfield, N. J., reported on development progress of high pressure short arc lamps in sizes from 800 watts to 2500 watts, and presented electrical characteristics, arc brightness, spectral energy distribution curves and applications of the different lamps studied.

J. M. Harris, Sylvania Electric Products Inc., Salem, Mass. discussed "The Effect of Outer Jacket Fill Pressure and Arc Tube Pressure on Mercury Lamp Performance".

Richard W. Mooney and W. Calvin Gungle, Sylvania Electric Products Inc., Towanda, Pa. and Salem, Mass., respectively, reported on "Fluorescent Lamp Performance As Affected by Impurity Gases". Water, vapor, hydrogen or hydrocarbons are detrimental to fluorescent lamp maintenance, they stated.

C. W. Pearson, E. A. Lindsday and R. T. Dorsey, General Electric Co., Cleveland reported on "Characteristics and Applications of Axial Filament Lamps", and concluded that "(axial filament lamps) offer the user an important increase in efficiency and lumen maintenance, . . . All fields of application will benefit . . . the CC-8 (filament) creates new opportunities for more effective reflector design".

M. J. B. Thomas, K. H. Butler and J. M. Harris, Sylvania Electric Products Inc., Salem, Mass. reported on "Phosphors for High Pressure Mercury Lamps" and indicated, with supporting data, that orthophosphate phosphors will give more lumen output and will be used to increase efficiency as compared with the older concept of using phosphors solely for color improvement.

John F. Waymouth and Erwin F. Lowry of Sylvania Electric Products Inc., Salem, Mass., and Francis Bitter of Mass. Institute of Technology, Cambridge, Mass. discussed "Factors to be Considered in the Design of High Output Fluorescent Lamps" and concluded that "use of neon as a filling gas results in a higher ceiling (to the light output) and also in higher efficiency at high power inputs than



when color helps your clients sell this lightingware helps your customers sell color

Paints and Paisley prints, flowers and frocks and furniture, foods—all sell best when your customers' customers can see colors as they actually are.

And you create illumination that shows colors in stores as they appear in natural light with Corning Alba-Lite. Engineered Alba-Lite is not color-selective. Reds are not weakened. Deep colors show naturally. Alba-Lite doesn't alter the color of products with any tinge of its own.

Besides the wonders it works in showing off colors, Corning Alba-Lite gives business places comfortable, glareless illumination. Its smooth diffusion of light (a result of the composition of Alba-Lite) surrounds customers with even illumination. You can use it rewardingly in full or partial luminous ceilings and in individual fixtures.

Alba-Lite is lightweight, never loses its light-transmitting qualities, doesn't sag, can't attract dust. It's easy to maintain.

And it's not at all expensive.





When you plan lighting for new or modernized business places that depend on the color of merchandise to make sales, look into Corning Alba-Lite. Alba-Lite lets colors be as they are.

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 Why waste time worrying with many materials, from many sources, for splices and terminations? PLM Unit Package Kits simplify planning and estimating...provide complete materials in one package for correctly designed splice or termination. Supplied for rubber, synthetic, VC or paper-insulated cable metallic and non-metallic sheathed - for ratings through 23 kv. Write for catalog.

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Before you specify any Time Switch check these TORK plus-value features!

- ✓ Double Pole, 3 Pole and Two Circuit Switching
- ✓ High Quality all-brass plates and gears
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TORK'S practical "Complete Line" provides the widest variety of timing dials, rugged switches, and all-purpose enclosures to meet any automatic ON-OFF application. TORK has been an exclusive manufacturer of high quality Time Switches for over 33 years.



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WRITE NOW FOR COMPLETE **DETAILS and SPECIFICATIONS**

GUARANTEED 3 YEARS

Low Cost TORKMASTER #948 TORK CLOCK Co., Inc

MOUNT VERNON, NEW YORK



the use of argon".

W. Calvin Gungle, John F. Waymouth and Horace M. Homer, Sylvania Electric Products Inc., Salem, Mass., reported on "Operating Parameters of High Output Fluorescent Lamps". They concluded from their studies that "it is possible and practical to double and even to quadruple the amount of light obtainable from a given fluorescent lamp".

Research Session

"Lighting Requirements Older Workers" was reported on by Sylvester K. Guth, A. A. Eastman and J. F. McNeils, General Electric Co., Cleveland,

"The Evaluation of Discomfort Glare", the numerical assessment of the capacity of a single glare source to produce discomfort, was presented by Glenn A. Fry, School of Optometry, Ohio State University, Columbus.

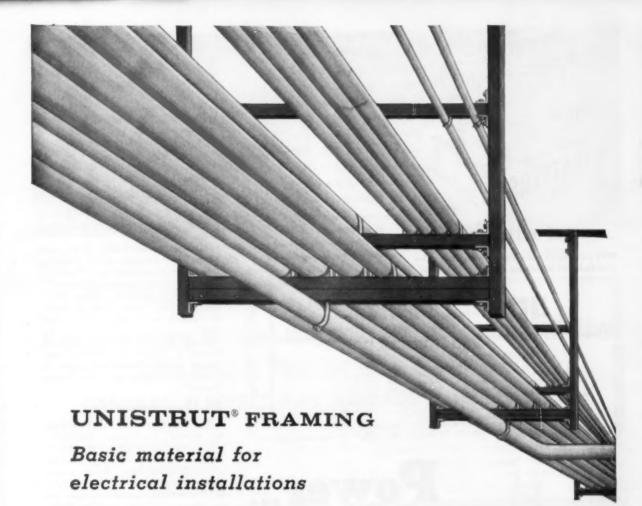
"EFAS-A New and Vital Aid to Low Visibility Landings by Aircraft" was discussed by Donald I. Coggins, Sylvania Electric Products Inc., Salem, Mass. EFAS-Electronic Flash Approach System-has just been approved for installation at Logan International Airport, Boston, by Civil Aeronautics Administration, it was revealed, following use of a similar installation at Newark (N. J.) Airport on an experimental basis for several years, and another installation at Idlewild Airport, New York depot for international planes, made late last year.

Street Lighting Session

J. R. Brass and Harold Skootsky. California State Highway Dept., San Francisco, Calif., and G. A. Trosper, Pacific Gas & Electric Co., San Francisco, Calif., described "A New Approach to Highway Tunnel Lighting", in which they reported on continuing studies on four tunnels in the San Francisco Bay area.

George A. Nagel of Connecticut State Highway Dept. reported on "A Highway Lighting Test Installation" in which he presented information and public opinion data pertinent to the problem of lighting turnpikes so as to be pleasant and attractive as well as safe for night

Dan M. Finch, University of California, Berkeley, Calif. discussed "Some Factors Influencing the Night Visibility of Roadway Obstacles", covering one phase of night visibility of the roadway scene having to do with street lighting and its evaluation in terms of



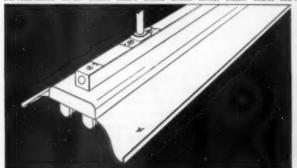


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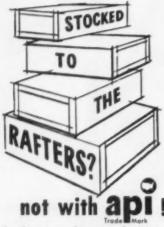
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the visibility of objects under specified conditions of observation. He summarized that "it is apparent that the final pavement brightness pattern is important, but also the lighting system used to obtain this pattern is equally significant".

Russell C. Putnam and Willard F. Gilmore, Jr., Case Institute of Technology, Cleveland, presented a report on "Discomfort Glare at Low Adaptation Levels 11-Of-Axis Sources".

Residence Lighting Forum

The IES Residence Lighting Forum held a 3-part session on home lighting.

Misses Emily Alexander and Nina Faye Bonner of the Georgia Power Co. gave a skit on "Planning Lighting With the Home Owner".

Nelson J. Bleisch, Union Electric Co., St. Louis, gave a paper on "Light for Living Indoors and Out"

Miss Ruth Patterson, Dallas Power & Light Co., Dallas, presented a slide-illustrated paper on "Designed Lighting for Texas Homes".

Lighting Progress Report

The Parade of Lighting Progress, an annual Conference highlight, was presented by James H. McCullogh, Independent Testing Laboratories, Boulder, Colo. Using slides, stage demonstrations, and exhibits, he dramatically presented new developments in light sources, lighting equipment, and lighting applications during the past year. Included were: electroluminescence, high intensity fluorescent lamps, tinted bulbs, colored PARs, 300watt flood lamp for photography, projector lamp for horizontal mounting, flat nosed reflector lamps down to 30-watts for home use, a new street lighting luminaire containing two banks of six 6-ft fluorescent tubes, a waterproof ballast, portable "downlight" for home use, new type of glass with surface treatment to prevent reflections, twinkle-light Christmas lamps, and many, many others.

Convocation Papers Session

A highlight of the Golden Anniversary program was a papers session with three featured speakers.

William Webster, Executive V-P of the New England Electric System predicted U. S. demand for electric power will rise 2000% in the next fifty years, during his address on "Atomic Power for Tomorrow's Lighting". More than 11,000 billion kwh of electric power



1. You'd want positive protection. General Electric gives it to you with two precision tripping actions—thermal and independent magnetic. You get double-barreled protection against short circuits and sustained overloads.



2. Wouldn't you demand the utmost safety to guard personnel? G.E. makes sure that the handle can't hold the contacts closed during a short circuit. The breaker can be switched by hand at currents even up to the full interrupting rating.

If you were writing the specs for your own circuit breaker installations, you'd insist on these four performance features GENERAL ELECTRIC HAS ALREADY BUILT THEM IN!

3. Dependability? You'd insist on years of it!

Quick-make, quick-break action prevents burning of contacts and lengthens breaker life. General Electric's de-ionizing arc quenchers assure efficient interruption and rapid cooling of arcs.

4. Naturally, you'd want fast installation, low-cost maintenance. G.E. accomplishes it with solder-less lugs, straight-in wiring and positive trip indication. And there are no fuses to stock and replace; fast restoration of service boosts production.





Finally, you'd specify a line to handle every low-voltage requirement (up to 600 volts, 800 amps), with a wide selection of accessories and a choice of separate enclosures. In fact, you'd ask for a line of General Electric molded case circuit breakers—available from your nearby G-E distributor. General Electric Company, Circuit Protective Devices Department, Plainville, Connecticut.

Progress Is Our Most Important Product

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"BUFFALO" PACKAGE, PROPELLER FANS

- Now! Many big jobs opened up by this big new line!
- New economy in first cost and installation cost!
- A new high in performance for propeller funs!

INSTALL 1 - OR 60



Above are some of the 60 "Buffalo" Design 53 Belt-Air Package Fans delivering 1,439,000 cfm on only 66 HP in a large Coliseum. Here's a new high in performance for these simple-to-install fans. Rugged, long-lasting construction too. 8" to 144" sizes. Think of the wide range of jobs you can handle easily, rapidly and to satisfaction! Write for prices, details today!

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OVERLOAD PROTECTION?

Here's what Pierce Renewable Fuses offer you:

- · Positive protection to equipment
- · Freedom from unnecessary blows
- · Link replacement in a few seconds
- · Far less maintenance and downtime
- Safety from dangerous afterblows
- Cooler operation 6 to 8 times longer fuse life

We invite you to compare the unique construction of Pierce Fuses with any other good make—to check their strong tubular bridge that assures proper link contact and knife alignment—their screen vented design that prevents temperature buildup—their link replacement that requires only a screwdriver. For convenience, for peace of mind, for lower downtime and fuse costs, no fuse offers you so much as Pierce!

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will be the demand on the nation's utility companies in 2006, Mr. Webster predicted.

Dr. R. G. Hopkinson, Department of Scientific and Industrial Research, Great Britain, said that "with pleasant lighting and bright colors in their classrooms, (English) pupils often don't want to go home when the school day is over". He spoke on the "Assessment of Brightness", or what we see.

Lighting Service Forum

Another highlight of the conference was the annual run-off of the "My Most Interesting Lighting Job" contest. There were ten contestants in this year's run-off, one from each of the Society's ten Regions. Installations covered included two floodlighting jobs, two residences, a gymnasium, a stained glass window, a store, two office buildings and an engineering office.

Winners in this contest were:

First Prize—B. F. Jones,
Smoot-Holman Co., Inglewood,
Calif.—Airesearch Co. Engineering
Office.

Second Prize—Miss Dorothy McGregor, British Columbia Electric Co., Ltd., Vancouver, B. C. (Canada)—Ease of Home Living.

Third Prize—E. H. Schaefer, Wisconsin Electric Power Co., Milwaukee—The Light is Right at Mutual.

Fourth Prize—L. N. Goodman, Louis N. Goodman and Associates, New Orlean, La.—Lighting Variety in a Modern Office Building (Shell Oil Co.).

Speaking at the opening session of the conference, IES President Robert F. Hartenstein said that an exhaustive effort to prevent a critical shortage of illuminating engineers during the next five years will be launched shortly. More than 3000 young men and women, specially trained in the complicated techniques of the science of lighting, will be required to meet public needs, and practically none are available now, he said. He further reviewed the Society's progress and activities during the past year.

Marshall N. Waterman, the Society's President-elect, reported that growing public demand for better lighting in the home is now making it essential that architects and interior designers expand their knowledge of modern illumination, and announced that plans are being completed to increase by 500% IES aid to the buildings, decorating and engineering arts through Universities throughout the country during the next 12 months to help

them meet this demand.

New B&D HEAVY Impact Wrench hits maximum torque in 6 seconds!

So rugged we dare offer a year's FREE SERVICE certificate!

In a grueling torture test, the *Power-Built* Black & Decker Heavy-Duty Impact Wrench ran for 500 hours of continuous operation without a breakdown—and was still going strong. Our special *free* service certificate is extra proof of its ruggedness. Yet this tool is so speedy, it hits maximum torque when other impact wrenches are just warming up.

Ask your B&D distributor today for a free demonstration, or write: The Black & Decker Mfg. Co., Dept. 2310, Towson 4, Md. No other manufacturer DARES MAKE THIS SPECIAL OFFER!

Every B&D Impact Wrench is covered for one full year by a free service certificate. It protects you against all maintenance costs resulting from normal use!

★ It costs less to maintain... lasts longer...runs cooler!

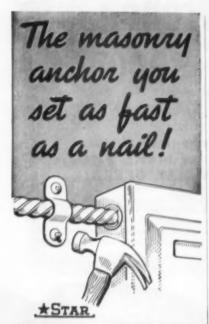
Packed with Advanced Features!

- Positive-Action Reversing Ring protected from accidental operation by stationary end cap.
- 2. Absorbs Shock—patented armature construction.
- Reduced Operator Fatigue—pistol grip handle and perfect balance provide maximum comfort.
- Lower Maintenance Costs—all mechanical parts are ruggedly constructed for longer service life.
- Plus Twice The Airflow of Comparable Tools. Can't Stall or Overload. Uniform Output. Rated above 120 Ft. Lbs. Torque.

Look in the Yellow Pages under "Tools — Electric" for Nearest Distributor.



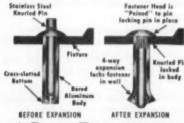
Portable electric tools . . . power-built to last!



PIN-GRIP DRIVE FASTENERS

Speed up fastening to brick, cinder block, concrete and other masonry materials. No special tools—simply insert the Pin*Grip through object to be attached into drilled hole in masonry, and drive the pin flush with the head, using an ordinary hammer. Pin*Grip holds fast, absorbs tensions, shocks, jars, and vibrations.

Ideal for electrical construction and maintenance applications such as conduit, pipe hangers, wiring clips, switch boxes, BX cable, wall boxes, etc. Standard packages of 3/16" and 1/4" diameters in varying lengths.



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P	Branch Office	a with !	locks
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LBE Launches Campaign To Push Retail Sales

Advertising and promotional activities of the LIVE BETTER... ELECTRICALLY long-range market development program is being concentrated this month to spur fall season retail sales and to stimulate demand for every kind of electrical product in the home.

The full story of the October retail campaign is told in an 8-page ad insert in major retailing publications. This special section gives retailers complete information about the profit potential the program offers, and spells out how national television and magazine advertising efforts will be pin-pointed this month.

Magazines and television activities on the national level, and the newspaper promotions on the local level, will carry the LBE messages to over 100 million people.

The fall campaign combines the activities of more than 2,600 electric distributors, 1,000 electric power suppliers, 75 electrical manufacturers plus their suppliers, 27 trade associations and 18,000 lending institutions.

Twin City AW Sales Run 80% Above 1955

Certifications under the Minneapolis-St. Paul Twin City Rewiring committee specialty-salesman selling program are running 80% ahead of 1955.

This six-months' certification report is bolstered by other rewiring statistics, says A. H. Kessler, executive secretary of the North Central Electrical League. Percentage of certifications which include range circuits are up from 45% to 64%. In Minneapolis alone, residential rewiring permits through June 1 were up 26%, with dollar valuation up 35%.

Prospect contacts under the program are made by salaried specialty salesman, working from leads generated by TV and newspaper advertising. Actual sales closings are made by contractors cooperating in the program, based on the general estimates given prospects by the specialty salesmen.

Each salesman, Kessler says, makes about five calls a day. The committee has found that, of prospect referrals, contractors close

Latrobe Electrical Products

"Latrobe" Floor Boxes and Wiring Specialties offer real economy in installation and replacement costs. Their unique design, free of unnecessary parts, means quicker installation and longer service.



Two Gang Adjustable Floor Box

Adjustable Boxes come in single-round or square bodies. Also in square type Single Gang, Two Gang, Three Gang and Four Gang Boxes.



"BULL DOG"
PIPE OR CONDUIT HANGER

Sturdy and dependable for hanging pipe to conduit $\frac{1}{2}$ ", $\frac{3}{4}$ " and 1" to steel beams up to $\frac{3}{6}$ " thick. Larger sixes for larger pipe.

Latrobe Products

Non-Adjustable Floor Boxes
Adjustable Floor Boxes
Gang Boxes . . . Cover Plates
Junction Boxes . . . Nozzles
Pipe or Conduit Hangers
Insulator Supports
Cable Supports . . . Fish Wire
Staple and Cable Clips
WRITE FOR NEW CATALOG

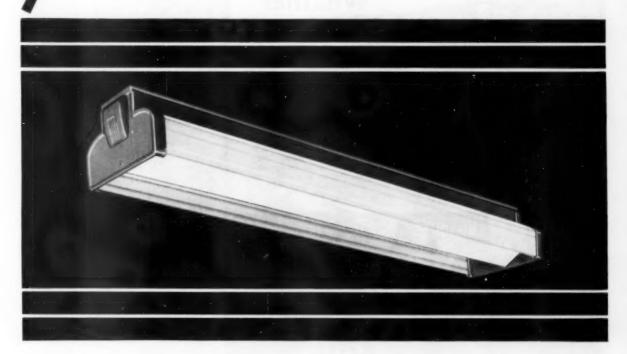
Sales Representatives in all principal cities.

Fullman Manufacturing Co.



SPECIFY CURTIS STORE-LITER

it's tops in style, in utilization, in value



Curtis Store-Liter is designed for modern stores where sales depend on high-intensity illumination to attract shoppers to shelved and displayed merchandise.

Store-Liter obsoletes glaring, bare lamp strip units, because the fine-ribbed plastic side panels refract and direct maximum light to the vertical and horizontal surfaces, making Store-Liter more efficient than bare lamp units. At the same time, the plastic panels provide 25° shielding.

Store-Liter's rugged construction of heavy gauge seel, finished light grey baked enamel—V-bar reflectors finished baked white Fluracite enamel—is guaranteed under standard service conditions. Scientifically designed, high quality side panels, supported by special spring steel clips at midpoint on 8' sections, assure long, efficient service.

Store-Liter has complete installation versatility. Store-Liter can be close ceiling or pendant mounted in continuous lines or individually, and they're available in 4' and 8' sections with Rapid Start, Slimline and Starter type lamps.

Store-Liter is available with white Fluracite enamel finished steel louvers that provide 37° crosswise and 30° lengthwise shielding, and with powerful in-line and corner downlights for 150-Watt projector spot or floor lamps.

Store-Liter is easiest to install. Luminaires are quickly and easily joined end to end with fittings supplied. A large end plate opening permits easy passage of circuit conductors through continuous lines without using chase bushings and locknuts. Special patented Curtis Sliding Clamp hangers permit complete flexibility of hanger placement.

And Store-Liter costs less to install. Store-Liter wire channels provide a continuous wireway that eliminates much of the cost for conduit, outlet boxes and fittings.

So send coupon for complete Curtis Store-Liter data and see for yourself how you can give your customers a store lighting luminaire that's better than strip at the cost of strip.



CURTIS LIGHTING, INC.

6135 W. 65th ST., CHICAGO 38, ILL.

in California

242 S. Anderson St. Los Angeles 33, California

in Canada

195 Wicksteed Ave. Toronto 17, Canada Curtis Lighting, Inc., Dept. 0-2, 6135 W. 65th St., Chicage 36, III. Send information on Curtis Store-Liter (uminaires to

Name

Affiliation

Address

Address.

r Zone Stat







with NELEX (MI) HEATERS

Many industries are finding Nelex MI heaters literally worth their weight in gold because they keep valves and solenoid plungers operating freely even in freezing weather. Even viscous liquids flow easily when pipes are heated with Nelex MI heaters.

Thermostatically controlled these versatile heaters put the heat where it is needed, when it is needed. They require no maintenance. They are low in first cost and economical to operate.

For additional information write for bulletin 1603 and special pipe tracing bulletin 54-11 or see your nearest Nelex distributor.

NELSON Electric MANUFACTURING CO.

P O BOY 5185

TELEPHONE RI 2-5531

A major source of electrical control equipment for industry.

EFFICIENCY Cable Strain Clamps
without Strain or Damage



. . . Withstands direct pull of 17,000 pounds

Efficiency Cable Strain Clamps lock cable safely and securely without possible strain or damage. "H" construction of clamps and high ridge across center of cable prevents

cable from slipping. Takes cable from 1/0 to 1,500,000 c. m. Three clamp sizes cover all cables sizes. Furnished with eye or clevis, for AC or DC Service.

Write for Catalog 38-A

"EFFICIENCY" DEVICES for CONDUIT and CABLE SUSPENSION



from 40% to 45%. This, however, is not "an accounting measure of the program," Kessler adds, since contractors don't usually report added sales leads resulting from original calls.

National Electrical Week

The extensive plans of Westinghouse Electric Corp. to participate in National Electrical Week next February 10-16 will carry the story of the annual observance into the homes of nearly 50 million Americans, Merrill E. Skinner, chairman of the National Electrical Week Committee, said in reporting on one phase of the Week's development

In announcing the plans that have been formulated by Westinghouse, Skinner said, "This is an outstanding example of the kind of cooperation we are receiving throughout the electrical industry. Other companies with major national advertising programs already have informally indicated their support, and we expect to announce the details of their participation in the near future."

Westinghouse plans include February 11, its "Studio One" dramatic program will carry a special NEW message. Four Westinghouse radio stations, in Boston, Cleveland, Pittsburgh and San Francisco, will carry NEW spot announcements day and night throughout the Week. All of the company's displays in national exhibits and trade shows during late January and early February will carry the NEW insignia or other material to promote recognition for the observance. Westinghouse advertisements in magazines and newspapers during February will carry an acknowledgment or a NEW slate wherever one can be fitted in. An issue of Westinghouse News, which is circulated to all of the company's employees, will be dedicated to NEW. As a part of its general community relations programs in the major cities throughout the nation where Westinghouse has sales offices, the company is preparing a talk for its executives to give to local civic and service groups. This talk will use NEW as its springboard and will be designed to stimulate appreciation of the electrical industry in the business and professional community. Finally, Westinghouse has informed the NEW Committee that the company's top sales personality, Betty Furness, will be available for NEW publicity and pictures.



and HONEYLITE—the all metal light diffusing acoustical honeycomb—made the change in record time!

When the Pacific Telephone and Telegraph Company designed this important nerve center for the 1956 Republican Convention at San Francisco's Cow Palace, they had one big goal—to make the room as well-lit and whisper-quiet as possible. That's why they chose a HONEYLITE ceiling! • HONEYLITE's amazing efficiency and sound reducing properties transformed the South Barn of the Cow Palace into this restful room—a room in which scores of messengers and 60 telephone representatives handled more than 4,000 long distance telephone calls a day. And HONEYLITE's 45° shielding turned a room designed for livestock into a setting for pretty telephone girls. HONEYLITE's low weight (2 ounces per square foot) meant that only the simplest T-bar suspension system was needed. On-the-job cutting and fitting reduced the man-hours needed to install the contoured ceiling to a minimum.

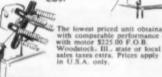
• The full air circulation given by all-metal, UL approved HONEYLITE made sure the Bell Telephone Center was not only smoke-free, but cool and fun to work in.

• For price lists and detailed information see your dealer or write to Hexcel Products, Inc., 951-61st Street, Oakland 8, California.





WINDING HEADS,
OTHER ACCESSORIES
AVAILABLE
AT EXTRA



EMONSTRATIO

Ask your Crown Distributor, or fill in and mail the coupon for coil winding equipment catalog NOW!

	AL PRODUCTS COMPANY set, Woodstock, III.
☐ We want a free "Series 50" Coi	demonstration of the Crown I Winder Drive.
Send us coil wi	nding equipment catalog.
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Company	
Address	
City	State



MILTON H. EISENHARDT, Merchantville, N. J., and Fred R. Pisano, Penn Electric Motor Co., Philadelphia, Pa., were in attendance at the NISA convention in Philadelphia, Pa.

Contractors, Utility Cooperate on Package

Cooperation between contractors and the utility has given birth to a rewiring package selling program in Superior, Wis. (pop. 35,000).

Beginning in May, a combination Housepower advertising and cold-canvass sales program was inaugurated by the Superior Water, Light and Power Co. and the town's three contractors. Thirty jobs had been sold through mid-August, with the program expected to pick up strongly in the fall.

The basic package sells for \$112. It includes 100-amp, 3-wire service, plus eight branch circuits, a 20-amp fused kitchen outlet and a 60-amp pullout for a range circuit. Range, dryer and water heater circuits are available on an optional basis.

The package is being sold doorto-door by the utility's two residential salesmen. The customer has his choice of the contractor to do the work.

Chattanooga Sets Awards

Customers with lighting installations meeting Certified Lighting standards will be presented their CLP certificates in Electric League of Chattanooga ceremonies Sept. 25. Buyers are customarily given their certificates on-the-job, following its completion.

At the same League meeting, students completing the CLP training course will be awarded diplomas. Two courses, with 60 graduates, have been given by the local CLP unit.

NOW! an uplight component in mercury high bay lighting



ABOLITE 24" ALUMINUM

... another exclusive ABOLITE development. The new ABOLITE 24" aluminum UPLIGHT LUMINAIRE was specifically designed for the H400-RC1 color improved mercury reflector lamp. This new luminaire is also used successfully with 1000 watt mercury lamps.

UPLIGHT LUMINAIRE

Unique open top design results in 18% uplight with H400-RC1, and 16% with H1000-C15 lamps.

ABOLITE UPLIGHT LUMINAIRES produce more comfortable lighting by reducing brightness contrasts between the lamp and the ceiling and upper walls. In addition, improved shielding provided by the luminaire further reduces glare. Lamps are kept cooler because excessive heat escapes through top, thereby increasing lamp life.

WRITE NOW FOR COMPLETE DATA





PUT AN END TO "TOSS-UP" SALES

Dodge Reports on new construction help take the "chance" out of selling

In the field of new construction, making a sale is possible only after someone has decided to build. After that it's no more than a "toss-up" that you will get the order unless you know where the sale can be made, on whom to call and when! Dodge Reports give you this sales-getting information. With Dodge Reports you'll know in advance who's building what and where, and when to make your bid for the business—you'll know the man to see, and when to see him. Furthermore, when you get Dodge Reports, you get more than routine advance information—you get the fastest, most complete construction news service you can economically use. Here's why...



BETTER REPORTING

Dodge employs more than 1,000 reporters covering every local area east of the Rockies. Backed by 65 years of service to the industry, together with the prestige of Dodge publications and services, only Dodge reporters have such welcome access to so many news sources in all construction fields.

SPECIALIZED BY FIELD

Dodge offers 3 specialized selling services . . . covering (1) General Building Construction, (2) Houses, and (3) Engineering Projects. You get thorough coverage of the type of construction that interests you without wading through piles of unnecessary reports. And by choosing just the service or services you need, you get the most economical reporting.

INDIVIDUALIZED FOR YOU

In addition to specialization by type of construction, Dodge makes it possible for you to select the type and the size of project on which you desire information, as well as the specific territory you want covered. You may choose whatever you need from the 26 different classifications in the General Building Service, 3 types in the House Service, and the 11 kinds of projects covered by the Engineering (Heavy Construction) Service.

There is a Dodge Reports Service for you. For complete information, write today. Use this coupon.



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Company	
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City	



Good-looking, extra shallow, rugged . . . engineered for severe weather and corrosive conditions

Entrances, canopies, lobbies, vestibules, corridors, shower rooms . . . this extra shallow recessed downlight meets all your requirements . . . where appearance is important and non-corrosiveness vital.

MOUSING . . . of 16 gauge galvanized . . . can either be used as a concrete pouring form . . . or mounted in recesses already provided by using wood forms. For plaster-type ceilings, use plaster frame. Attach hinged face plate and tighten acrews so Sealume gasket is compressed tight against the ceiling.

IT'S AVAILABLE with round or square diffusers providing either symmetrical or asymmetrical light distribution from 60 Watts to 300 Watts...extra shallow... with corresponding depths from 2½" to 6¾". Protective guards, if desired. For full data on this series, write for the "43" line.

1333 Willoughby Avenue, Brooklyn 37, M. Y.



Wage Increase In Seattle

Wages of about 1,200 electrical wiremen in Seattle, Wash., were increased by 10 cents an hour August 27, in accordance with a decision by the Council of Industrial Relations for the Electrical Contracting Industry after a recent hearing in Washington, D. C.

The journeyman's scale now is \$3.20 an hour, with another increase of 5 cents an hour to become effective January 1.

The Seattle local of the IBEW had sought a 13-cent increase now and 12 cents January 1. It agreed to accept the decision of the Council, sponsored jointly by contractors and the IBEW.

Fall Range Campaign

Built around the theme, "Nothing Measures Up to Electric Cooking", the Fall range campaign of the Edison Electric Institute has been announced by Robert L. Coe, chairman of the EEI Residential Promotion Committee and Residential Sales Manager of the Union Electric Company of Missouri.

The Campaign, which will run the months of September, October and November, offers many sales aids and materials designed for a locally coordinated electric range campaign. They include: a dealer display kit of 13 window and store display pieces, one stick-on sales reminder and a tetrahedron mobile hanger.



LIVELY SESSIONS on business and technology of the motor shop industry were well attended by members of the NISA, at their convention in Philadelphia, Including Joseph Hanle, Hanle Electric Co., Baltimore, Md., and George Saunders, Wirtanew Elect. Co., Ltd., Edmonton, Canada.



CHAMPION DIARMENT TOOL COMPANY

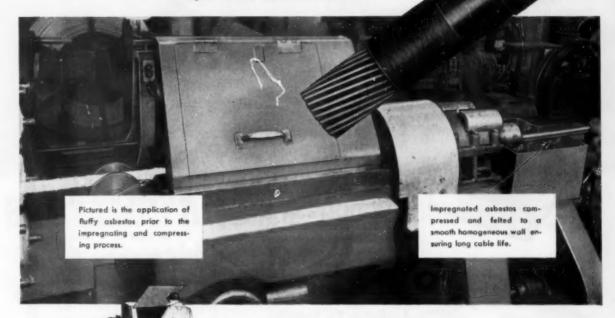
SELECTED COMPOUNDS in felted asbestos walls

+ quality varnished cambric tapes

add up to

ROCKBESTOS A.V.C.

(N.E.C. TYPE AVA) QUALITY



Compounds — specially selected compounds — which are used to impregnate asbestos walls, are one of the important reasons why you can count on Rockbestos A.V.C. for dependable, long lasting service.

For this impregnation, Rockbestos engineers not only set up rigid compound specifications but conduct a continuing testing program to insure that these standards are always met. Thus, the exactly right compound is applied to the asbestos wall at the correct temperature and at the correct pressure. The Result . . . the seamless, felted Rockbestos wall.

In Rockbestos A.V.C. impregnated felted asbestos walls seal varnished cambric tapes away from air and moisture. The tapes are made to Rockbestos specifications and are applied under controlled methods assuring uniform dielectric strength.

Rockbestos A.V.C. gives you long life and dependable service under every type of operating condition . . . in temperatures up to 230°F.

Complete construction and test specifications of Rockbestos A.V.C. are in the new booklet "Specification RSS-88".

Write today for your copy.

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LOS ANGELES • NEW ORLEANS • OAKLAND, CALIFORNIA • SEATTLE



STOCKED COAST TO COAST Standard Rackbastos A.V.C. construction (N.E.C. types AVA, AV8, etc.) are available for immediate shipment. Call or write nearest branch office.

What to PAY? Panelboard Uses Plug-In Components WHAT TO CHARGE?

With constantly changing materials prices it is a tough job for the electrical contractor to answer those two questions profitably.



Make the job easy, save time and money and insure your profit with

NATIONAL PRICE SERVICE CONTRACTOR'S GUIDE

Published by Henderson-Hazel Corp. 13601 Euclid Avenue CLEVELAND 12, OHIO

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about your service immediately and without obligation to:
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City Zone State

A completely new concept of panelboard design for industrial and commercial electrical distribution has been announced by Federal Pacific Electric Co., according to C. A. Schmidt, product sales manager.

"The new concept", Mr. Schmidt reported, "has been made possible by the advanced development of compact modular design molded case circuit breakers and standardized metalclad panelboard enclosures for power distribution busses rated up to 600 amps. With the new molded case breakers and enclosures, available nationally through electrical distributors, electrical contractors can quickly and efficiently assemble modern distribution panels on the job.

Vancouver Contractors **Elect Officers**

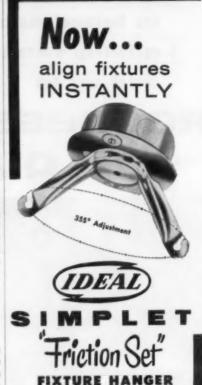
H. F. Hume, Hume & Rumble Ltd., was elected president of the Associated Electrical Contractors of B. C. at Vancouver, B. C. D. Carter, C. C. Carter & Son Ltd., was elected vice-president and W. Crouse, Peterson Electrical Construction Co., Ltd., was named secretary-treasurer.

Westinghouse Insulations **Available To Industry**

A complete line of flexible insulations and treated materials is now available from the Micarta Division of the Westinghouse Electric Corp.

George H. McBride, manager of the Division, said, "Until now, electrical insulating tapes and fabrics have been available only for Westinghouse equipment and interworks orders. The increased demand for these materials has prompted their release for industrywide use. Many varieties of papers and fabrics treated or impregnated with oils, varnishes, or compounds are included in the line."

Some of the applications of the products are: as end winding, padding, banding cushions, phase insulation, and various combinations for slot insulation, all in the Class "A" range. Also available are many newer materials in the Class "B" and Class "H" temperature ranges designed to meet the requirements of today's trend toward greater output from smaller units.



· As Easy as Putting A Bulb in a Socket

A twist of the wrist turns fixture to any alignment-after hanger has been attached to any 31/4" or 4" outlet. Base and receptacle are stationary-arms revolve 355°. Once lined up, exclusive FRICTION RING holds fixture firmly in selected position. Receptacle is mounted at factory-ready for use. Complete with two 5' chains, hooks and cord clips. Order from your distributor or write for information and prices now.





Bend without flattening, pull without snagging with General Electric EMT

Continuous weld seam on G-E EMT makes installation easier

Because the continuous weld seam on General Electric EMT eliminates weld metal, there are no burrs to snag conductors or tear insulation. General Electric's strong welded seam won't split or cause flattening during bending. Controlled, continuous induction welding makes the difference. G.E. adopted induction welding because it eliminates the sewing machine-like "stitch" produced by other types of welding. Induction welding means easier handling and faster wiring. General Electric EMT also offers these additional advantages:

COLORED BUNDLING TAPE for quick indication of size.

EASY BENDING because only the finest cold-rolled steel is used.

FAST WIRE PULLING because of the low-friction interior surface provided by Glyptal* lacquer and the smooth welded seam.

EXCELLENT CORROSION RESISTANCE because the interior is protected with tough Glyptal lacquer, and the outside is coated with electro-galvanized pure zinc.

FIND OUT how you can speed your wiring jobs with G-E EMT. See your General Electric Construction Materials distributor or write Section C60-1018, Construction Materials Division, General Electric Company, Bridgeport 2, Connecticut.

*Registered Trade-mark General Electric Company



Axial cross section





Interior surface

You can see the difference in these photographs. Compare axial cross section and interior surface of G-E EMT (left) with competitive brand (right). O.E.'s smooth weld is produced by continuous induction welding—and only General Electric EMT has it.

Progress Is Our Most Important Product

GENERAL (ELECTRIC

NEW... UNIQUE... DESIGNED FOR ELECTRICIANS...

Model M-2 POWERTESTER

Accurately tests all power circuits.

For checking fuses, switches, circuits, motor and transformer windings, relay and contractor coils, leakages and resistors. Light weight—sturdy—accurate—with separate probe handling up to 4/0 wire.



- 3 AC-DC Voltage Ranges Measure 1 - 500 Volts
- 3 Current Ranges
 Measure 0.1 50 Amperes
- 3 Resistance Ranges Measure 0.2 - 1,000,000 Ohms

Ideal for testing for overloads when checking old homes or factories for rewiring business. Tells everything you want to know. Clip-on ampore probe and test leads. Rugged, handsome vinyl sarrying case.

Made by the Atomic Engineering Corperation, designers and manufacturers of quality instruments for the U. S. Army and Navy.



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Enclosed is my	sheek	Money
order	for \$	
to me prepaid.	M-2	Powertesters.
Send COD (not	propaid)	

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City. Zone State



MOTOR SHOP business and technical subjects discussed at the recent convention of the National Industrial Service Association in Philadelphia were of keen interest to all members attending the sessions, including A. T. Volland (left), Volland Electric Equipment Co., Inc., Buffalo, N. Y., and A. S. Tracy, A. S. Tracy Co., Concord, N. H.

NISA News

The new NISA Year Book, the association's annual directory, was issued last month listing 1,457 active, 72 associate and six "privileged" members as of July 15. "Privileged" members are individuals no longer associated with a member firm, but who once represented a member in the association and who wish to maintain their contacts. The six include Rudy Scherer of Indianapolis; Frank T. Foshee, Houston; L. H. Lanahan, Memphis; Frank W. Wiley, Cincinnati; Charles J. Cannon, Farmington, Mich.; and Leonce Bonnecaze of Slidell, La.

NISA's international scope is indicated by Year Book listings of shops in Mexico (3), Trinidad, Cuba (2), Puerto Rico as well as 40 members in six Canadian provinces and one member each in Alaska and Hawaii.

Copies of the Year Book are sent to each member and additional copies of the geographically-arranged list of members are available from NISA National Headquarters, 818 Olive St., St. Louis 1, Mo. for \$2 each. Checks or money orders should accompany orders.

Gerald J. Connor of Stearns, Perry & Smith Co., Boston, has been named president of the prison reform society, Guild of Our Lady of Ransom, Norfolk Chapter. Mr. Connor is also serving his second term as president of the Boston Chapter of NECA, and is president



It's a pleasure to use good tools—pliers that grip tight... that cut through tough wire easily... that reach confined spaces.

Linemen and electricians know that they can rely on their Kleins—side cutters, long nose, oblique cutters—famous for quality for a century.

There is a Klein Plier exactly suited to every electrical need carried in stock by better electrical suppliers everywhere.

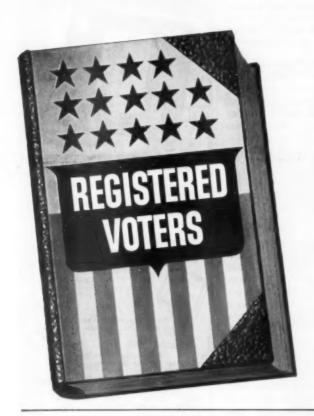


Write for your FREE copy of the Klein Pocket Tool Guide listing Klein equipment and giving valuable information.

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If you're not in the book you're

a man without



. . . . a country

. . . . a state

. . . . a county

. . . . a town

. . . . a party

. . . . a street

. . . . a school

. a vote

Look at all the things you can lose, if you're not a registered voter.

If you're not in the book, you lock yourself out of the elections. The polls are closed to you. You can't vote on streets, or schools, councilman or mayor (not to mention congressman, senator or president). You don't even have the right to complain about your government and the way things are run!

But more than that, you cut yourself apart from your neighbor next door, your friends at the shop, your fellow members in union or club.

You lose the right to look that boy of yours in the eye when he wants to know if you're doing your part.

And you lose the self-respect that comes from knowing you can walk into the polls on Election Day—the one place in the world where all free men are really equal. Isn't it too much to risk for the little time that registering takes?

Get your name in the book

and do it now!

Is your name in the book?



The NEW



GENERAL PURPOSE

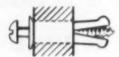
WOOD ANCHORS

EASIEST OF ALL WOOD SCREW ANCHORS TO INSTALL. Takes screw sizes #4 to #9.

FOR USE IN BRICK, CEMENT, CON-CRETE, TILE, WALLBOARD, WOOD, METAL, ETC.

FOR PERMANENT RUST PROOF INSTALLATION

These ANCHORS are ideal for mounting such articles as FIXTURES and General Equipment around the Office, Factory, and Home.



U.S.E. GENERAL PURPOSE ANCHOR IS EASY

Drill hole, as recommended in wall where fixture is to be mounted.

Insert anchor in hole, and place fixture, insert screw and tighten.

The tough plastic anchor expands under pressure when screw is tightened, making a secure installation.

SOLD ONLY THROUGH RECOGNIZED DISTRIBUTORS

U. S. EXPANSION BOLT CO.

YORK, PA. DEPT. EC-10

of the Quincy, Mass. Boy Scout Council.

Midwestern Chapter met September 22 at Hotel Lafayette in Clinton, Iowa.

Great Lakes Chapter visited the city of Adrian, Mich., and the shop of former NISA director William Saunders (Lenawee Electric Co.) on August 20. Dinner was served at the Eagles restaurant for the group which traveled to the city from Detroit by chartered bus.

The Florida Section of NISA's Southeastern Chapter held a meeting in Tampa, August 24, at the Hillsboro Hotel, J. Arthur Turner, Sr. was in charge of arrangements.

Bob Shakstad of Shakstad Electric and Machine Works, Sioux Falls, S. D., has bought controlling interest in the shop from his father, Oscar Shakstad. The elder Mr. Shakstad will retain office space in the company's building.

When the Niagara and Ontario Chapters held their joint meeting September 15 at Niagara Falls, Ont., the two chapters toured the Sir Adam Beck Power Plant.

The production of Brook Motors was a feature of chapter meetings in Memphis, September 14-15, and in New Orleans, August 28. Peter Loewe, vice-president of the firm, used color slides to illustrate his talk. The Memphis meeting was a gathering of NISA's Mid-South Chapter. The New Orleans meeting was of the New Orleans Chapter.

Louisville Chapter held its annual outing at Blackstone's Mill, Ind., August 2. Owen Gollar Jr. of Owen Gollar Electric Co., Inc., was in charge of arrangements.

North-Central Chapter met September 21-22 at Stoddard Hotel in LaCrosse, Wis.

After a summer recess of two months, NISA's New York Metropolitan Chapter held its first fall meeting September 20 at Gondolier Restaurant.

At the joint conference of Southern California Chapters in San Diego, August 11, speakers included Frank Broiles of International Electric Co., Inc., Los Angeles, who compared American



WASS. . "PHILADELPHIA, PA. . ROCHESTER, M. Y.

and foreign motors; Earl Sweinhart of Sweinhart Electric Co., Los Angeles, who discussed paper work methods; and William M. Hogue of Larsen-Hogue Electric Co., spoke on NISA history. Hogue is a pastnational president of NISA. The members of the two chapters from San Diego and Los Angeles visited the Ets-Hokin & Galvan shop in San Diego. Local arrangements for the program, including the women's activities described elsewhere in this column, were handled by San Diego members Charles Norris and Frank Sloan and their wives and Mrs. Robert Norris.

Members of NISA's Los Angeles Chapter toured the Pasadena shop of Pompey Electric Co. after a dinner meeting. Twenty-eight attended the meeting which was held in August.

Members of three NISA chapters in the Pacific Northwest held the 3rd Annual NISA Pacific Northwest Conference, October 5.

A NISA Associate member, Lenni Products, Inc., of Lenni, Pa. celebrated its 10th anniversary last month with a modernization program, adding a new wing to its building and opening a products control and quality testing laboratory.

The 1st Southern California Chapters Conference was held in San Diego, August 11, at the Lafayette Hotel. Charles Norris of the San Diego Chapter and Russell Lockard of Los Angeles Chapter were co-chairmen. The program included trips to the city's zoo, lunch at the Starlight Roof Garden of El Cortez Hotel via the 15-story glass elevator outside the structure which gives passengers a spectacular view of the city, and a dinner and visit to San Diego's Starlight Opera where the group saw a performance of "Hit the Deck."

President Covington, Vice-President Alfred Elson Jr., Secretary Paul Sievert, Treasurer Frank W. Ross and Directors John W. Overton, H. C. Blenkhorn, Joseph H. Previty and Executive Secretary Fred B. Wipperman, met September 15 in an Executive Committee meeting at the Park Hotel in Niagara Falls, Ont. The group also attended a joint meeting of the Niagara and Ontario Chapters which was held at the same time.

Stuck Valves
Hard-to-Heat Spots
Frozen Pipes
Sluggish Materials
Underheated Rooms



Do something about it NOW! This FREE book tells you how



Here's brand new application information on hundreds of uses of Chromalox Electric Heating Equipment for winter weather problems. These factual reports provide you with a rich source of ideas tailored strictly to winter heating problems in and around the plant and office.

Whether it's room heating, deicing, snow melting, warming of materials, or any of a hundred winter heating jobs, this exclusive information will show you how to solve the problem the electrical way.

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MAIL THIS TODAY!

V	Thomas Boulevard, Pittsburgh 8, Pa. Gentlemen: Rush my copy of How to Solve Winter Problems with Electric Heat to:
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5 Good Reasons Why-

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ENDS FITTING PROBLEMS!



ELECTRIC TUBE PRODUCTS

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Book Reviews

1955 CIE Proceedings

The Proceedings of the 1955 Technical Sessions of the Commission Internationale de l'Eclairage (International Commission on Illumination), held in Zurich, Switzerland in June of 1955, have been published and made available. These 1955 Proceedings have been prepared in two volumes, each containing about 800 pages and including more than 300 black-and-white illustrations and twelve color prints.

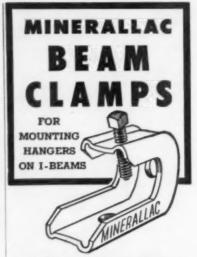
Last year's meeting was the 13th Session of the Commission. It was attended by more than 500 delegates from 27 countries, including 36 delegates from the U.S.A. Dr. Ward Harrison of the United States, who completed his four-year term as President of this international organization last year, presided over the Sessions.

Parallel meetings were held by the 35 Technical Committees of the Commission. Each of these Committees presented a technical report for discussion. In addition, 34 papers were presented, of which six were of U.S. origin. These were: Visual Research in the United States, by C. L. Crouch; Recent Studies of Visual Discrimination, by H. R. Blackwell; Fundamentals of Museum Lighting, by Laurence S. Harrison; Physiological Bases of Disability Glare, by Glenn A. Fry; Electrical Measurements of Fluorescent Lamps, by E. H. Salter, R. G. Slauer, and Arthur Weeks; and Subjective Additivity Sources of Brightness, by S. K.

Seven of the Technical Committee Reports were compiled by U.S. Secretariat Directors, as follows: Airport Lighting and Signals, by W. C. Fisher; Color of Signal Lights, by F. C. Breckenridge; Predetermination of Illumination and Luminance, by W. M. Potter; Colorimetry, by D. B. Judd; Lighting for Photography, Cinema and Television Production, by A. H. Kliegl; and Operating Accessories, by E. H. Salter.

For the purpose of easy reference all material relating to a given subject has been carefully correlated.

Price of the two volumes, sewn in cloth, is \$15.00 per set, including shipping charges. Available from T. D. Wakefield, Treas., U.S. National Committee, CIE, c/o The Wakefield Co., Vermilion, Ohio.



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DATES AHEAD

International Association of Electrical Inspectors—Section meetings: Eastern Section—Wentworth-by-the-Sea, Portsmouth, N. H., Oct. 15-17; Southern Section—Statler-Hilton Hotel, Dallas, Texas, Oct. 22-24; Canadian Section—Park Plaza Hotel, Toronto, Ontario, Canada, Nov. 2-3.

National Safety Council—44th Safety Congress and Exposition, Conrad Hilton Hotel, Chicago, Ill., October 22-26.

Fiorida Association of Electrical Contractors—Fourth Annual Convention and Electrical Show, Balmoral Hotel, Miami Beach, Fla., Oct. 24-27.

National Electrical Manufacturers Association — Annual meeting, Traymore Hotel, Atlantic City, N. J., November 12-16.

Operations Research Society of America—Tenth National meeting, Hotel Mark Hopkins, San Francisco, Calif., November 15-16

American Institute of Electrical Engineers—Winter general meeting, Hotel Statler, New York, N. Y., January 21-25, 1957.

National Electrical Week-An all-industry event, February 10-16.

National Electric Sign Assn.—Annual convention and exhibit, Sheraton Park Hotel, Washington, D. C., February 24-28.

American Society of Heating and Air-Conditioning Engineers — Annual meeting, Chicago, Ill., February 25-28.

13th International Heating and Air Conditioning Exposition — Chicago, Ill., February 25-March 1.

National Electrical Manufacturers Assn.—Edgewater Beach Hotel, Chicago, Ill., March 11-14.

Fourth National Electrical Industries Show—Sponsored by Eastern Electrical Wholesalers Assn., 71st Regiment Armory, New York City, April 8-11.

National Association of Lighting Maintenance Contractors—Fourth Annual Meeting, Hotel Muelebach, Kansas City, Mo., April 29-May 1.



BUSINESS METHODS and motor shop technology are subjects close to the hearts of (L. to R.) Walter E. Ziegenbein, Chicago, Illinois, G. E. Jones, past president of NISA and president of G. E. Jones Electric Co., Inc., Amarillo, Texas, and J. G. Hupp, Electric Motors Co., Cedar Rapids, Iowa, shown here at the NISA convention in Philadelphia.



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Headquarters Announcements

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Kuhlman Electric Co., Bay City, Mich .- J. H. Watkins and A. V. Hughes, vice presidents of sales and engineering.

Nelson Electric Mfg. Co. has relocated its main plant. New address is P. O. Box 5385, Tulsa, Oklahoma.

General Electric Co., Plainville, Conn.-Circuit Protective Devices Dept. is the new name of the G-E division formerly known as the Trumbull Components Dept.

Kelman Electric & Mfg. Co., Los Angeles, Calif .- A. E. Mackenzie, vice president and general manager of this newly acquired subsidiary of I-T-E Circuit Breaker Co.

Sylvania Electric Products Inc., Salem, Mass .- H. F. Callahan, general manager of the lamp division.

Bryant Electric Co., Bridgeport, Conn.-C. L. Wood, general sales manager.

Pierce Renewable Fuses, Inc., Leicester, N. Y.-Sherwood De-Wein, vice president.

Corp., Westinghouse Electric Pittsburgh, Pa.-L. L. Clark, sales manager of the Sunnyvale plant; H. H. Humphry, transformer sales manager; T. R. Lawson, manager of the Control Dept. at Buffalo, N. Y.

Jefferson Electric Co., Bellwood, Ill.-B. J. Farrell, sales manager of the Wholesale Division.

Termite Drills, Inc., Pasadena, Calif.-F. H. Denman, sales man-

Westinghouse Electric Corp., Bloomfield, N. J .- J. G. Carroll, manager of the Ken-Rad Lamp Dept.

Sequoia Process Corp., Redwood City, Calif .- W. W. Valentine, president.

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Allis-Chalmers Mfg. Co.: R. H. Cline, Pittsburgh manager of the Industries Group.

National Electric Products Corp.: J. M. Cosgrove, New York district manager and G. R. Ericson, assistant manager in the same dis-



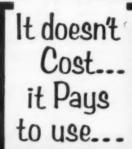
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EAST CENTRAL

Bell Sound Systems, Inc.: H. H. Seay, representative for western Pennsylvania, Ohio, West Virginia, Kentucky and Indiana.

Line Material Co.: C. W. Puent, field engineer for Chicago and northwestern Indiana.

Curtis Lighting Inc.: Frank Bernd, Chicago sales manager.

National Electric Products Corp.: E. M. Perrott, midwest regional operating manager, offices in Chicago; A. Kopald, Milwaukee district manager.

BullDog Electric Products Co.: C. F. Ortolf, field engineer in the Indianapolis, Ind. district.

Electro Silv-A-King Corp.: O. E. Barron, district manager for Louisiana, Mobile, Ala., southern Mississippi and Pensacola, Fla. Offices in New Orleans.

Advance Transformer Co.: W. M. Walsh, sales representative for the Midwestern region, head-quarters in Chicago.

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Line Material Co.: L. L. Fleege, central Iowa field engineer at Des Moines; R. J. McGeever, field engineer for eastern Iowa and northwestern Illinois; P. S. Scott, field engineer for western Iowa, and adjacent portions of Nebraska and South Dakota; J. R. McDonald, field engineer for southern Idaho and eastern Oregon.

Westinghouse Electric Corp.: G. W. Butler, St. Louis district sales manager for the Lamp Division

Plymouth Rubber Co.: Arbeiter-Steele Co., representatives for St. Louis region.

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Hubbard and Co.: R. M. Waggoner, vice president and general manager of Pacific Coast operations.

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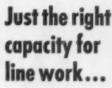
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SELECTING LOW-VOLTAGE CONNECTORS [FROM PAGE 128]

more economical to produce. They work as well for aluminum as for copper cable.

There is another wedge type terminal or lug. This one is applied with a tool and is limited to wire size up to No. 4. Although made of copper, the connector may be used on aluminum. Its cost of production, however, has caused it to give way to the less expensive indent type connector.

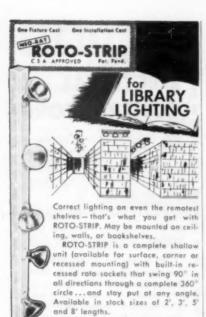
The indent type connector is available in sizes for conductors up to and including 1,000,000 circular mils. In the larger sizes, however, they are usually referred to as compression type.

The compression types, sometimes called circumferential pressure type, compress a stranded cable uniformly around its periphery, reducing the area to a compact section within the conductor. It is almost a cold-welded job, pressing out most of the voids between the wire strands and broadening the contact areas from strand to strand. The compression connector is the best choice for aluminum cables, because it minimizes the adverse effect of aluminum's oxide film. When applied to aluminum, it shows the best end results in uniform distribution of current into each strand in the cable.

Die shapes for installing compression connectors are hexagonal, square, oval and round. The hexagonal form most nearly accomplishes the ideal compression, a compression in which the cable is squeezed down to a solid while it still maintains its round conformation, Fig. 5. For aluminum it is especially desirable to compress the conductor within the connector so that they almost cold weld into each other, locking the cable in place to reduce and prevent creep, to which aluminum is susceptible.

The Contacts

The key to metal-to-metal contact between the connector and the flat bus bar or stud to which it is bolted is clean surfaces. Copper terminals and bus bars are likely to be dirty. Aluminum lugs and bus bars are almost certainly



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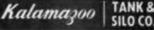
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covered with a resistant oxide film.

Effective techniques for cleaning aluminum also apply to copper. Bus bar and connector tongue surfaces should be scrubbed with a fiberglas brush, a medium grit emery cloth or sandpaper. The cleaned surfaces should immediately get a protective coat of inhibitor grease. Another method is to coat the surface with grease and then to scrub the surface through the grease.

Plating—silver, gold or tin—on terminals is an attempt by the manufacturer to keep the contacts clean. Plated terminals, therefore, should never be abraded nor scrubbed. They should be given a coat of oxide inhibitor, and their bolts drawn tight.

A neutral grease should be used in the joint between the conductor and the terminal. It is not essential for copper, because pressure causes the strands to rub each other and clean themselves.

High pressure over a wide area is another requirement for good contacts. Large flat washers used between the bolt heads or the nuts and the lug tongue spread LIKE A THIRD STRONG ARM...

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pressure and also prevent the nut from chewing up the surface of the tongue. Belleville type washers used on top of larger flat steel washers are recommended for aluminum lugs. The washers should be tightened until flat. The nut may then be backed off about a half turn to let the washer exert its spring pressure.

Grounding

Everything said here about connections for current-carrying wires also applies to grounding connections. A grounding system must be capable of carrying any fault current that could possibly get into it, Fig. 4. The importance placed on a ground-system, whether from conduit to conduit or from neutral conductor directly to the ground, also includes the system's joints. Briefly, good connections in a grounding system are vital for safety.

In conclusion, any type connector is satisfactory for copper conductors, provided the connector bears the UL label. For aluminum conductors, the choice is limited. First, the connector must be intended for aluminum. Secondly, they should also be made for one conductor size.

The compression connector fills more requirements of all type jobs than does any other kind of connector-long service, insurance against damage to the system by short circuit currents, immunity against high temperatures and corrosive atmospheres. But there is no single best connector for all uses, and the design engineer or the contractor should make the choice based upon his knowledge of the job and the cost of the installation.



THREE MEMBERS who attended the business and technical sessions at the NISA convention in Philadelphia, Pa., are: Walter H. Gruger, The Phoenix Electric Co., Youngstown, Ohio; Arthur Hendrickson, Duncan Electric Co., Duncan, Oklahoma; and T. E. Greve, Greve Electric Co., Houston, Texas.

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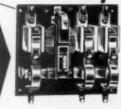
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